SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY 1926.

GENERAL PHYSICS.

210. *Polymolecular and Monomolecular Films.* **W. D. Harkins** and **J. W. Morgan.** (Nat. Acad. Sci., Proc. 11. pp. 637–643, Oct., 1925.)—The film of phenanthrol spread on an aqueous solution of $CaCl_2$ exhibits characteristic monomolecular properties. When compressed, no force of compression is apparent until the area per molecule is decreased to 36·5 Å.U. The increase of compressive force is linear until it reaches 32 dynes/cm. and 21·5 Å.U. molecular area. From this the increase is again linear but with a steeper slope. At 44 dynes/cm. it collapses. The mean thickness of the film is 7 Å. at the point where force first appears, and 12 Å. at collapse. Similar results are obtained for other substances, but sometimes with only one linear portion. With polymolecular films the curve of compression is not linear. For a mixed film of phenanthrene and stearic acid, the area per molecule at collapse is practically the same as for the acid alone. Collapse thus occurs when the stearic acid is torn from the water. W. G. B.

211. *Spontaneous Ascent of a Liquid Film along a Surface that it Wets.* **C. E. Guye.** (Arch. des Sciences, (Supplement No. 2.) 7. pp. 78–80, July–Aug., 1925. Paper read before the Soc. de Physique et d'Histoire Naturelle, Geneva.)—The time, t, to rise a distance, h, is found to be

$$t = C\frac{\eta}{\rho g}\left(H \log_e \frac{H}{H-h} - h\right)$$

where η = coefficient of viscosity, ρ = density, H = limiting height attained. W. G. B.

212. *Ascent of a Liquid Film and Energy Problems in Relation to the Ascent of Sap.* **C. E. Guye.** (Arch. des Sciences, (Supplement No. 2.) 7. pp. 63–68, July–Aug., 1925. Paper read before the Soc. de Physique et d'Histoire Naturelle, Geneva.)—In a previous note it was shown how energy considerations led to a determination of the limiting height that a liquid film will rise up a surface that it wets, but precise results were not obtainable in the absence of knowledge of the relation between surface energy and thickness of film, for thicknesses less than the "normal thickness." It is now pointed out that the normal film cannot be in stable equilibrium unless the energy E per unit area is less for the normal than for any less thicknes, t. Then dE/dt will represent a force of suction. Now consider a wet tube terminated at its upper end by a surface from which evaporation is taking place. The film there is, in consequence, thinner than the normal, and so this force of suction will draw more liquid up the tube. The process will also be self-regulating. It is also shown how a knowledge of E will determine the maximum height and the maximum rate of the drawing-up of the liquid. W. G. B.

213. *Viscosity of Liquids under Pressure.* **P. W. Bridgman.** (Nat. Acad. Sci., Proc. 11. pp. 603–606, Oct., 1925.)—The changes in viscosity which take place as the pressure is varied from atmospheric pressure to 12,000 kg./cm.^{2} are given for water at four temperatures and for 42 other liquids at 30° and 75° C. Normally the viscosity and the temperature coefficient of viscosity increase with great rapidity as the pressure rises, though water is anomalous at low temperatures and pressures. The rate of increase is very different for different substances and appears to depend on the complexity of the molecule: this point is brought out by the results for a series of alcohols. These results do not bear out the theories given by H. B. Phillips [Abstract 286 (1922)] and L. Brillouin [Abstract 251 (1923)], and it is suggested that viscosity is partly due to interlocking between the liquid molecules. C. W. H.

214. *On the Viscosity of Ammonia Gas.* **R. S. Edwards** and **B. Worswick.** (Phys. Soc., Proc. 38. pp. 16–23; Disc., 23, Dec., 1925.)—The viscosity of ammonia gas has been determined at three different temperatures by transpiring the gas through a capillary tube which had previously been calibrated with air. Sutherland's constant is found to be roughly 370, and the mean collisional area of the ammonia molecule $0 \cdot 633 \times 10^{-15}$ sq. cm. AUTHORS.

215. *The Reaction of a Perfect Incompressible Fluid on an Immersed Solid in Steady Motion.* **M. Roy.** (Comptes Rendus, 181. pp. 541–544, Oct. 26, 1925.)—Obtains an integral formula which is the generalisation of the theorem of Joukowski. W. G. B.

216. *The Darcy Filter Formula.* **O. Emersleben.** (Phys. Zeits. 26. pp. 601–610, Oct. 3, 1925.)—Investigates mathematically the percolation of water through sand, etc., by means of an ideal case, the flow being parallel to the axis of cylinders equally spaced in a two-dimensional lattice. A solution is obtained in terms of Epstein's Zeta Function, and the ratio of the mean velocity to the pressure gradient is $a^2 f(\rho)/\mu$, a being the lattice constant, μ the viscosity, and ρ the fraction of the section occupied by the cylinders. When the obstacles are not cylinders, a mean value must be taken, and a table of $f(\rho)$ is given for this purpose.
W. G. B.

217. *The Motion of an Air Bubble rising in Water.* **O. Miyagi.** (Tôhoku Univ., Technol. Reports, 5. No. 3. pp. 1–33, 1925. In English.)—In this paper air bubbles of various sizes moving up in still water are carefully treated experimentally and then theoretically [see Abstract 740 (1925)]. Full details of apparatus with diagrams and five plates are included. It is found that when an air bubble rises from rest in still water it attains a constant terminal velocity almost as soon as it has started. The terminal velocity is a maximum (27·8 cm. per sec.) for a bubble whose radius is equal to the critical radius, *i.e.* about 0·165 cm. For bubbles smaller than the critical radius, the terminal velocities increase approximately linearly with their sizes. For bubbles larger than the critical radius, the terminal velocities decrease in nearly parabolic relation with their sizes, and tend to be constant irrespective of their sizes (about 23 cm. per sec.). The rate of resistance almost suddenly increases at the critical radius, and the shape and course of the bubble become unstable at this radius. The bubble traces a kind of a helical course on its upward motion and it displays a flattened outline, the major axis of which lies perpendicular to its course. The ratio of the mass of water carried up with a passing bubble to that displaced by it is proportional to the square of its radius or to its surface area. The resistance to motion of a bubble is proportional to the cube of its radius or to its volume. The following equation of motion agrees closely with the practical case, with the axis of z upwardly directed, $\rho v d^2z/dt^2/k = g\rho v - \phi(dz/dt)^2$, where ρ is density of water, v volume of bubble, ϕ coefficient of resistance depending on size of bubble, and k another coefficient also dependent like ϕ. The boundary effect of the experimental vessel is also included. H. H. Ho.

218. *Flow of Fluids in Curved Passages.* **J. Eustice.** (Engineering, 120. pp. 604–605, Nov. 13, 1925. Paper read before the British Assoc., Southampton, Sept., 1925.)—Uses the coloured filament method previously described [Abstract 989 (1925)]. In striking contrast with the spiral or vortex action observed in circular pipes, experiments on the flow of water in small curved passages of rectangular section show that, with small velocities, the filaments remain "parallel" to one another as they flow round the bend. At higher velocities it is possible to produce vortices similar to those in pipes of circular section. The passages in question measured 2 cm. by 0·125 cm., had transparent sides and were bent on edge through 180° in the plane containing the longer of these two dimensions. When the lengths of straight pipe of circular section equivalent to the excess loss due to curvature, expressed in diameters of the pipe, are plotted against the ratio of the radius of curvature to the diameter of the pipe a curve is obtained in which the maxima and minima do not occur at equal intervals. The author explains this effect in the light of his experiments. H. N. A.

219. *The Modulus of Elasticity. Temperature and Melting-point.* **W. Widder.** (Phys. Zeits. 26. pp. 618–622, Oct. 3, 1925.)—The modulus of elasticity of paraffin has been determined by Segel at different temperatures. If E_0 is the modulus at 0° C. and E_t the modulus at some other temperature t° C., then the following relation obtains:—

$$E_t = E_0 - ct,$$

where c is a constant. By the method of least squares

$$E_0 = 253{\cdot}3 \text{ and } c = 5{\cdot}614.$$

Using these values, the values of E for various temperatures are calculated and compared with the experimental results of Segel. They are found to be in close agreement. If it is assumed that E is zero at the melting-point τ° C., then $E_0 - c\tau = 0$, or $\tau = E_0/c$. This gives a value 45·1° C. for paraffin.

The method with suitable modifications is applied to metals, bearing in mind that the variation of the modulus of elasticity is in general a linear function of the temperature, and between the interval $-186°$ to $20°$ the following equation holds: $\eta_t = \eta_{20}\{1 - a(t - 20)\}$. The method is developed for a large number of metals and their melting-points, etc., found as for paraffin. Finally the expression for the variation of the elasticity modulus is given as $E_t = E_{t'}\{1 - \epsilon_{t'}(t - t')\}$ where $\epsilon_{t'}$ is the temperature coefficient. A relationship is attempted between ϵ_t and β_t the linear expansion coefficient. Further it is known that the product of the melting-point temperature and the coefficient of expansion is approximately a constant; hence it is sought to establish linear relationships between the quantities, melting-point, elasticity modulus, and temperature. The results are in remarkable agreement and are embodied in a final table containing details for 23 metals, as also in a curve showing the close linear relation. S. G. B.

220. *The Transverse Vibration of Uniform Beams.* **D. M. Smith.** (Engineering, 120. pp. 808–810, Dec. 25, 1925.)—The importance of considering the transverse vibrations of uniform beams is demonstrated by the behaviour of stays, tubes and pipes connected to high-speed machinery, and by the similar phenomena of the critical speeds of long line shafts. This paper derives and applies a new formula which simplifies the calculation of periods of vibration of multi-span beams, and also enables rational calculations to be made for a case of considerable practical importance hitherto little treated, *viz.* that of a beam held at the ends in elastic fixings which imperfectly constrain its direction. This fundamental formula differs from that of Darnley [see Abstract 1188 (1921)] in involving functions relating only to one span at a time, and it lends itself admirably to nomographic calculation by which approximate solutions are obtained rapidly and easily without the use of tables. The paper concludes with an example of a complete calculation by the author's method. H. H. Ho.

221. *An Analogy between Pure Mathematics and the Operational Mathematics of Heaviside by Means of the Theory of H-functions.* **J. J. Smith.** (Frank. Inst., J. 200. pp. 519–534, Oct., 1925.)—In this paper an attempt is made to reconcile the operational methods of Heaviside with the methods of pure mathematics [see Abstract 1628 (1923)]. In order to do so, certain modifications in the conceptions of function, limit, differential coefficient, etc., are suggested. The new definitions are called H-functions, etc., and have the property that they give the same results as the present definitions at ordinary points, *i.e.* points at which there are no discontinuities, etc. The difference in the results obtained by both methods is pointed out by reference to well-known cases. The use of these H-definitions in determining Green's functions in the conduction of heat or electricity and in potential problems is shown. To do this it is necessary to extend the use of the Heaviside "unit function" with respect to time to the other coordinates, and to develop an analogue of the Heaviside expansion in three dimensions. The use of the Green function and two well-known theorems to obtain solutions under arbitrary initial or boundary conditions is illustrated by two examples. The procedure in solving such problems is standardised, and it appears that by its use most of the problems given in Carslaw's "Mathematical Theory of the Conduction of Heat," second edition, 1921, or Byerly, "Fourier Series and Spherical Harmonics" or other such works, may be readily solved. H. H. Ho.

222. *Cristobalite.* **L. Longchambon.** (Comptes Rendus, 181. pp. 614–616, Nov. 3, 1925.)—Drawings are shown illustrating the successive changes of cristobalite into the stable crystalline form, tridymite, when maintained between 870° C. and 1470° C. in a suitable solvent, by solution and subsequent re-precipitation of silica. The polymorphism is shown to be continuous in the sense that the general orientation of the cristobalite is preserved in the resulting tridymite. The densities of the two forms at ordinary temperatures, 2·27 for tridymite and 2·34 for cristobalite, are in closer agreement when allowance is made for their respective dilatations at 1000° C., becoming 2·20 and 2·22 respectively. A. B. C. L.

223. *Crystal Structure and Chemical Constitution.* **K. Weissenberg.** (Zeits. f. Physik, 34. 5–7. pp. 406–419, 420–432 and 433–452, 1925.)—The so-called transformation properties of an object are identical for all possible systems of coordinates, and must be regarded as a material property of the object itself. Crystals are *highly* homogeneous discontinuities (only continuities are *strictly* homogeneous), and they are distinguished from other material objects by special transformation properties, which makes it necessary to treat their structural theory in a special manner. This theory is developed in Part II and a system of tables is indicated in which, taking into account the fact that every symmetry group of Schoenfliess is built up of other symmetry groups (principal and subsidiary groups), a finite number (about 10,000) of principal lattices have to be included. The arrangement of crystals in this detailed system brings the relation between structure, chemical constitution and physical properties clearly to expression. In Part III two new conceptions are introduced ; "islands" are groups of particles M, which either have all particles or none in common with other structurally identical groups. CO_3 in $CaCO_3$ forms an island, since it has no particle in common with other CO_3 groups ; a quantity of $CaCO_3$, on the other hand, has at least one other quantity which is structurally equivalent to it, and which has at least one but not all particles in common with it ; it is not an island. There are also island chains, island networks and island space lattices, built up of micro-islands. In considering the dynamical structure of the crystal, dynads are introduced, groups M of atoms in which each atom is held to the rest by stronger forces than to any atom not contained in the group M ; and in this way a new system of tables is formed, by means of which the structure of crystals can be described simply. The idea of molecules, which at first was only defined for vapours and solutions, can be transferred to the dynads of the crystal. Every dynad is an island, but the converse is not true. The idea of islands is a purely geometrical one, while that of dynads is dynamical. H. N. A.

224. *X-Rays and the Constitution of the Hydrocarbons from Paraffin Wax.* **S. H. Piper, D. Brown** and **S. Dyment.** (Chem. Soc., J. 127. pp. 2194–2200, Oct., 1925.)—The X-ray photographs of seven hydrocarbons isolated from Scottish paraffin wax show, in each case, one set of planes with a large spacing and two or three smaller "side spacings." The side spacings are the same for all the substances, but the large spacings increase with the molecular weight and the appearance of the plates suggests that they belong to a series of some kind. Comparison of the photographs with those given by synthetic triacontane, dotriacontane,

and tetratriacontane shows that, for six of the seven, each hydrocarbon spacing agrees almost exactly with a whole number of carbon atoms, which may be regarded as the number of carbon atoms in the substance.
T. H. P.

225. *Method of Following, by Means of X-Rays, the Course of Certain Chemical Reactions* (*Oxidation of Unsaturated Fatty Acids*). **J. J. Trillat.** (Comptes Rendus, 181. pp. 504–506, Oct. 19, 1925.)—By means of the method previously described [Abstract 1818 (1925)] it is found that the oxidation of unsaturated fatty acids is effected by successive additions of equal quantities of oxygen and is accompanied by a series of almost equal molecular elongations of the order 6 to 7 Å., the structure being thus rendered unstable and polymerisation consequently occasioned.
T. H. P.

226. *Investigations of the Absorption of Hydrogen by Palladium by Means of X-Ray Spectrograms.* **F. Krüger** and **A. Sacklowski.** (Ann. d. Physik, 78. 1. pp. 72–82, Nov., 1925.)—It is not possible to decide directly, by means of X-ray spectrograms, whether the hydrogen atoms absorbed by palladium are situated between the atoms of the palladium lattice or replace them in the lattice. At 0° C. and 760 mm. Hg pressure the volume absorbed is 623 times that of the palladium, and there is one H to two Pd atoms; the lattice is face centred cubic, $a = 4 \cdot 00$ Å., and the density calculated on the assumption that H replaces Pd in the lattice is 7·3; the observed value is 10·76 and that calculated on the assumption that only palladium atoms build up the lattice is 10·9, so that it is clear that H does not replace Pd in the lattice. An investigation of the absorption of H by alloys of Pd and Ag leads to the conclusion that H forms solid solutions with Pd up to a certain degree of saturation, and the lattice becomes larger; the addition of silver to palladium also enlarges the lattice in accordance with Vegard's law. If for any of these alloys the lattice is smaller than that of H-saturated palladium, the alloy is capable of absorbing H to an amount depending on the enlargement of the lattice still possible. With about 70 % Ag the lattice is of the same size as that of H-saturated palladium, and for higher percentages of silver no more hydrogen is absorbed.
H. N. A.

227. *The Isotropic Ion and the Structure of Molecules and Crystal Lattices.* **F. Hund.** (Phys. Zeits. 26. pp. 682–685, Nov. 3, 1925. Paper read before the Deut. Physikertag, Danzig, Sept., 1925.)—Kossel has assumed that many molecules are built up, not of neutral atoms, but of ions the electrostatic forces between which hold the molecules together [Abstract 641 (1916)]. The lattice theory also in many cases assumes that crystals are built up of oppositely charged ions, and the calculated energy of the lattice in such cases agrees with that deduced from thermochemical data. To find the energy of the molecules in the gaseous state their polarisation in an electrical field has also to be taken into account. The ions which in the free state have no privileged direction are known as isotropic ions, and the author's problem is to discover how far the facts can be explained by their means. The energy of the different types of lattice, such as the CsCl, NaCl and ZnS types, is calculated, assuming isotropic ions, for different values of n, the exponent in the term b/r^n which governs the repulsion when the ions are forced together. The results are plotted, and it is shown that the actual arrangement in each case is such as to give the minimum energy. The same is true of lattices of the types CaF_2, TiO_2 and Cu_2O, though here the possibility of polarisation has to be taken into account more frequently, and the lattices may cease to be coordination lattices and molecular and layered lattices, like those of CdI_2, ZrS, $ZrSe_2$, MoS_2, result. H. N. A.

228. *The Separation of Chlorine into Isotopes and the Whole Number Rule for Atomic Weights.* **W. D. Harkins.** (Nat. Acad. Sci., Proc. 11. pp. 624–628, Oct., 1925.)—Previous work on the separation into isotopes has been mainly based on the separation, by diffusion, of chlorine heavier than the ordinary gas. The author and F. Jenkins have recently separated a lighter gas, and details are given of the chemical methods used in determining its atomic weight. That of ordinary Cl is found to be 35·457, agreeing with the result of S. B. Stone; for the light isotopic chlorine separated the value 35·417 was obtained. H. N. A.

229. *Average Cross-Sectional Areas of Molecules by Gaseous Diffusion Methods.* **E. Mack, Jr.** (Am. Chem. Soc., J. 47. pp. 2468–2482, Oct., 1925.)—Diffusion coefficients are determined by measuring the rate of evaporation of the various substances through an air-space. Powdered charcoal is placed on the side of the space away from the substance and it is assumed that immediate absorption occurs on contact of the diffusing substance with the charcoal. From the diffusion coefficients the average cross-sectional areas of the molecules of iodine, benzene, naphthalene, anthracene, toluene, diphenyl, aniline and benzidine are calculated by the Stefan-Maxwell-Jeans equation in which

$$S^2 = \sqrt{c_1^2 + c_2^2}/3\pi D n(1 + a)$$

where S is the average radius of the diffusing molecule and that of the air molecule; c_1 is the mean velocity of the molecules of the diffusing vapour and c_2 that of the air molecules, and n is the number of molecules in 1 cc. of the gas.

The cross-sections of molecules so determined agree closely with the values calculated from the molecules proposed by Bragg from X-ray analysis, the calculation being made by a shadow-projection method. Values determined from Huggins' models do not agree with the diffusion values quite so well. It is shown that the carbon atoms in the chain of the *n*-octane molecule are probably arranged in the zigzag manner found by X-ray examination by Müller and Shearer for the alcohol part of ester molecules. The diffusion method confirms the conclusion, based on chemical evidence, that diphenyl and benzidine have a collapsed structure. [See Abstract 2348 (1922).] J. N. P.

230. *The Allotropy of Manganese.* **A. J. Bradley.** (Phil. Mag. 50. pp. 1018–1030, Nov., 1925.)—Manganese from different sources was analysed by the X-ray powder method. The photographs suggested the presence of allotropes, so specimens were quenched from different temperatures and examined. Two of these allotropes (β and γ) are normally present in commercial manganese. β is stable over the range 150° C.–850° C. and γ from 650° C. upwards. Within the range 650° C.–850° C. both forms are stable, and the element here appears to show the phenomenon of isodynamic allotropy, an equilibrium mixture of the two allotropes corresponding to each temperature. The third allotrope, which has so far only been found in electrolytic manganese, may be regarded either as a face-centred tetragonal structure with axial ratio $a : c = 1 : 0 \cdot 9445$ or as a body-centred tetragonal structure with axial ratio $1 \cdot 34 : 1$. It is therefore intermediate between a body-centred and a face-centred cube. It is only stable at low temperatures. On heat treatment this α manganese is converted into the β and γ forms, but the change is not reversible. A. A. D.

231. *Forces between Atoms.* **A. Korn.** (Accad. Sci. Torino, Atti, 60. 2 and 3. pp. 41–45, 1924–1925.)—Atoms are supposed to be made up of three kinds of particles, positive and negative charges and gravitative bodies. The forces between them are all of the form $CF(r)e^{-kr}$ where C is a constant varying with the type of particle. Then for the force between gravitative particles the constant is $-\alpha$; between gravitative and positive, $+\beta$; between gravitative and negative, $+\gamma$; between positive and positive, $-u$; between positive and negative, $-v$; between two negatives, $-w$. Then if the number of the particles (a, b, c) correspond to the known elements, it is possible to have equilibrium when:— $\frac{3}{4} < \alpha \lessgtr 1$, $\beta = 1$, $\gamma = \frac{1}{8}$, $u = \frac{7}{8}$, $v = \frac{1}{8}$, $w \lessgtr \frac{1}{28}$.

The necessary conditions for stability are:—

$$(a-1)\alpha \lessgtr b\beta + c\gamma \lessgtr a\alpha$$
$$(b-1)u \lessgtr a\beta - cv \lessgtr bu$$
$$(c-1)w \lessgtr a\gamma - bv$$

The paper concludes by giving a table showing the possible values of (a, b, c) for the elements up to chlorine. Up to boron a single solution is possible, from carbon to aluminium two solutions, and from silicon to chlorine three solutions. A. Wh.

232. *Atomic Structure.* **Pérot.** (Soc. Franç. Élect., Bull. 5. pp. 569–580, July, 1925.)—A very condensed sketch of modern theories of atomic structure and the experimental evidence on which it is mainly based. A. Wh.

233. *The Law of Force and the Size of Diatomic Molecules, as determined by their Band Spectra.* **R. T. Birge.** (Nature, 116. pp. 783–784, Nov. 28, 1925.)—Assuming the law of force between the atoms of a diatomic molecule to be of the form $F = k_1(r - r_0) + k_2(r - r_0)^2 + k_3(r - r_0)^3 + \ldots$ in which r_0 is the inter-nuclear equilibrium distance, and that the rotational energy of a non-vibrating molecule is given by $E_m = Bm^2 + Dm^4 + Fm^6 + \ldots$ where m is generally an exact half integer, the values of $k_1, k_2, k_3 \ldots$ may be expressed as explicit functions of B, D, F, etc. ... Further, k_1, k_2 and k_3, and in some cases k_4, may be calculated from vibrational energy data. Values of k_1 and k_2 so calculated from data referring to the λ3883 cyanogen band are in fair agreement. The two methods of calculation applied to bands in the spectra of CuH, N_2^+ and N_2 likewise afford results in satisfactory agreement. It is considered that these results conclusively favour the acceptance of the customary values of the moments of inertia of non-polar molecules rather than the new smaller values. [See Abstracts 1390 and 2275 (1925).] J. S. G. T.

234. *Equilibrium of Two Electrons and a Nucleus Governed by Coulomb's Law.* **U. Crudeli.** (N. Cimento, 2. pp. 225–234, July–Aug.–Sept., 1925.)—The necessary condition is derived for the stability of such systems uniformly rotating. It is also shown that neutral systems of this type cannot exist. The paper is mainly mathematical. A. Wh.

235. *Mechanism of Radiation.* **O. Lodge.** (Experimental Wireless, 2. pp. 884–888, Nov., 1925. Presidential Address to the Radio Soc.)—In the first part of this paper the radiation from a Hertzian oscillator is considered. The author inclines to the view that the loops of lines of force given off by such oscillators have a real existence and that the quantum arises from this reality. Absorption of radiation is considered from the quantum standpoint. The second part deals with atomic radiation and particularly with J. J. Thomson's attempt to reconcile the corpuscular and wave theories of light, each of which explains certain phenomena difficult, if not impossible, to explain by the other. Lodge suggests that Thomson's corpuscles are themselves of the nature of waves in some respects, though apparently vortex rings, but vortex rings with a wave-length equal to their circumference. A. W.

236. *Maxwell's Electromagnetic Ether and the Michelson-Morley Experiment.* **A. Press.** (Phil. Mag. 50. pp. 809–812, Oct., 1925.)—The author observes that the fact that light manifestations according to Maxwell require an etheric and not a material medium calls for an interpretation of Gladstone and Dale's so-called molecular refractive index. His conclusion is that as a consequence of the mass action of the earth producing a filling up modified ether medium, only relatively small results can follow from exponents of the Michelson-Morley or of the Lodge type. In contradistinction, due to the mass action of the sun, it should necessarily follow that an observed bending of the rays should take place, due to the modified etheric atmosphere set up. G. W. de T.

METEOROLOGY AND GEO-PHYSICS.

237. *Atmospheric Pollution. Report on Observations in the Year ending March* 31, 1925. (Meteorolog. Office, Air Ministry, M.O. 280. [46 pp.] 1925.)—For earlier report see Abstract 2016 (1924).

238. *Report on the Phenological Observations in the British Isles from December,* 1923, *to November,* 1924. **J. E. Clark, I. D. Margary** and **R. Marshall.** (Roy. Meteorolog. Soc., J. 51. pp. 293–333; Disc., 333–335, Oct., 1925.)

239. *Periodicities in European Weather.* **D. Brunt.** (Roy. Soc., Phil. Trans. 225. pp. 247–302, Nov. 12, 1925.)

240. *Solar Variation and the Weather.* **C. G. Abbott.** (Science, 62. pp. 426–428, Nov. 13, 1925.)—In recent papers Marvin and Kimball [see Abstracts 255 and 256 (1926)] maintain that the variation of the solar constant has only an insignificant influence upon the weather. The present paper is a rejoinder contraverting this view. A. A. D.

241. *Opacity Factor for Short-Wave Solar Radiation and for Atmospheric Processes.* **W. Hartmann.** (Meteorolog. Zeits. 42. pp. 337–344.

Oct., 1925.)—Observations over three years at the Taunus Observatory were made by a photo-electric method to determine the opacity factor for the atmosphere. The Na cell employed was sensitive over the range 300–600 $\mu\mu$ with a maximum at 390 $\mu\mu$. For the short-wave region the opacity was less dependent on the water content of the atmosphere than for the whole spectrum. The opacity was dependent on the number and size of the particles in the air. The opacity factor was correlated with the absolute humidity, and daily and monthly mean values determined for it. Seasonal relations between the two were also calculated. The opacity was further correlated with wind direction and precipitation, and its mean value found in the different quadrants of a depression and an anticyclone and also for other types of weather. Regions of maximum and minimum opacity in a depression and anticyclone were located. It was shown that surfaces of discontinuity affect the opacity factor and the movements and location of these surfaces may thus be traced. Finally a linear relation between opacity and total water content is found which permits conclusions being drawn regarding the entry of dry and warm air masses into the upper air, although it is here assumed no change occurs in the size of the particles. [See also Abstract 2210 (1924).] R. S. R.

242. *Measurement of the Amount of Ozone in the Earth's Atmosphere.* **G. M. B. Dobson** and **D. N. Harrison.** (Phys. Soc., Proc. 38. pp. 74–75; Disc., 75–76, Dec., 1925.)—The quantity of ozone present in the atmosphere has been measured by spectroscopic means on about a hundred days. A marked connection with the pressure distribution at the surface, and particularly with the conditions at about 10 km., has been found. AUTHORS.

243. *A Review of Hygrometry in Mining Practice.* **D. Hay** and **W. E. Cooke.** (Colliery Guardian, 130. p. 1295, Nov. 27, 1925. Paper read before the Midland Inst. of Mining Eng., Leeds, Nov., 1925.)—The special features and uses of the following types of hygrometers are discussed (1) Wet- and Dry-Bulb, (2) Dew-point, (3) Hair, and (4) Absorption Hygrometer. For use in mines preference is given to the first, provided efficient ventilation is obtained. The objections to the most important sets of psychrometric tables for general mining purposes are stated and the new tables of Jones are considered the best, although different units for density are often preferred. R. S. R.

244. *Glacier Flow.* **G. Aliverti.** (Bol. del Comitato Glaciologico Italiano, No. 6 [11 pp.], 1925. Extract.)—Experimental test on viscous fluids in sloping canals. Stokes's formula and Somigliana's theory (Accad. Lincei, Atti, 30. 1921) give the same values for μ, this being derived in the latter from the deformations of lines drawn across the flowing substance. The observed movement of glaciers corresponds to that of a viscous fluid. A. D.

245. *Isostasy.* **C. E. Dutton.** (Washington Acad. Aci., J. 15. pp. 359–369, Sept. 19, 1925. Reprint of an address read before the Phil. Soc. Washington, April, 1889.)—This classical paper is noteworthy for two points: (1) the substitution of movements caused by isostatic adjustment for the older contraction theory to account for folding of the earth's crust; and (2) the suggestion that the cause of the movement was expansion of rock material below the crust. This paper was the first to give the general applications of the theory of isostasy. W. A. R.

ASTRO-PHYSICS.

246. *Distribution of Stars in Globular Clusters, M9, M10, M12, and Kinetic Theory of Gas.* **C. Parvulesco.** (Comptes Rendus, 181. pp. 500–502, Oct. 19, 1925.)—From plates taken at Lick and measured in Paris, the author finds for star density curves in M9, M10, and M12, that the peripheral density diminishes in proportion as the central density increases, and that the densities at the centres are 4000 to 6000 times those at the peripheries. He considers the theoretical comparisons, by v. Zeipel and H. C. Plummer, of a gas globe and a cluster; these urged as a first proof that the systems are similar because the two curves are closely approximated. Unlike them, he concludes that the value of the specific heat cannot be derived from the physical constitution of the observed clusters. He finds that, in general, two globes of gas in adiabatic equilibrium have different curves of distribution if they have different masses or mean densities, and therefore a globular cluster of stars must be compared with a gaseous globe equal to it in mass—that is, with a spherical nebula. A. S. D. M.

247. *Effect of Varying Mass on Binary System.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 85. pp. 912–914, Oct., 1925.)—A reply to E. W. Brown [see Abstract 2050 (1925).] The author asserts that "the theory of relativity limits us quite definitely to the first alternative" form of the equations of motion, namely, mass × acceleration = force, and therefore Ma = constant, and not a = constant as Brown deduces. He finds that the velocity dx/dt undergoes small fluctuations of the order dp/dt times the linear dimensions $[p = (m_1 - m_2)/2(m_1 + m_2)]$ of the orbit, about a constant value, again in accordance "with the theory of relativity which shows that a binary system acted on by no external forces cannot develop a secular acceleration"; also that, in the general case, the areal velocity and the eccentricity retain constant values throughout the motion as opposed to Brown's "increase of distance, increase of eccentricity and increase of velocity of centre of mass," and his adoption for the scheme of equations, rate of change of momentum = force. A. S. D. M.

248. *Orbit of the Spectroscopic Binary* 16 *Lacertae.* **O. Struve** and **N. T. Bobrovnikoff.** (Astrophys. J. 62. pp. 139–143, Oct., 1925.)—The orbit of the spectroscopic binary 16 Lacertae was derived from thirty-one spectrograms obtained with the one-prism Bruce spectrograph of the Yerkes Observatory. The period is $12^d{\cdot}3106$. The Ca lines H and K show a stationary velocity of $-18{\cdot}9$ km./sec., while the velocity of the centre of mass of the binary is $-6{\cdot}9$ km./sec. The component of the solar motion in the direction of this star is $+10{\cdot}3$ km./sec. AUTHORS.

249. *Tests of Spectroscopic Parallaxes and Absolute Magnitudes by Double Stars.* **G. Shajn.** (Astrophys. J. 62. pp. 104–113, Sept., 1925.)—To test the accuracy of the spectroscopic methods for determining absolute magnitudes and parallaxes by the criterion that $\Delta M - \Delta m = 0$, 194 double stars were examined. Fifty-five were of late, and 139 of earlier, spectral types. The *derivation of* M *for later spectral types* is found satisfactory, the value of $\Delta M - \Delta m$ being between $\pm 0 \cdot 28$ and $\pm 0 \cdot 48$, which corresponds to an accuracy in the parallax of 14 to 25 per cent. of the parallax itself. For spectral types A and B, the accuracy is considerably less, the average value of $\Delta M - \Delta m$ ranging between $\pm 1 \cdot 08$ and $\pm 1 \cdot 24$, corresponding to 65–77 per cent. of the parallax itself. The correlation between spectral type and absolute magnitude for the A and B stars is evident for such stars in moving clusters, but much less evident for individual stars of known trigonometric parallax. These stars show very large deviations from the reduction curve and a considerable dispersion of M. AUTHOR.

250. *The Riddle of ϕ Persei.* **J. F. Frédette.** (Roy. Astron. Soc. Canada, J. 19. pp. 185–196, Oct., 1925.)—This star has been known as a binary since 1902 and has been investigated spectrographically at Ottawa, Potsdam, and Allegheny, in 1910 and 1913, and also recently with a prismatic camera by Lockyer at Sidmouth. [Abstract 2047 (1925).] On the Ottawa spectrograms the hydrogen emission at $H\beta$, $H\gamma$, $H\delta$, and $H\epsilon$ appears as double bands separated by a narrow absorption line: the latter, under very favourable conditions of contrast, shows a complex structure suggesting the presence of two partly overlapping bands, and it undergoes a continuous change in intensity, sharpness and width through two equal cycles of 63 days during the period of varying radial velocity of 126·5 days. These changes are undoubtedly responsible for the large number of excessive residuals in the three first investigations mentioned above, in which the velocity was derived from direct measures of the hydrogen lines; and Lockyer's new method, which avoids the influence of ambiguity in position, wave-length and changing character of the central absorption, affords a valuable check on the others. He finds the velocity of the absorption with respect to the emission by determining the differences of intensity between the two bright components of the emission band, measuring the intensities by means of a graduated wedge. Some new plates have now been taken at Ottawa, the old plates have been re-examined, and a comparative study has been made of the results of all the four investigations. The velocity curves, determined in different ways, the changes in emission intensity and the changes in character of the absorption bands are all shown in a diagram. It is concluded that no important shift of the hydrogen absorption can be assigned to tidal or pulsation effects, that the emission has its source in only one star of the binary system, but the absorption in both, and that one of the causes of irregularities in the velocity curve is that a weak absorption line (from star I) gradually blends with the main absorption line (from star II) which is superposed on the emission slightly to the red and is, of course, stationary with respect to the emission. The question of the variation in the emission intensity of the bright star is bound up with that of the amount and shifting position of the absorption of the faint star, and apparently it cannot be elucidated until we have more accurate knowledge of the orbital elements and a light-curve. It is suggested that, since uniformity in sharpness of focus at the individual hydrogen lines is here of exceptional importance, a somewhat stiff film might be substituted for the photographic plate and the film-holder be made to conform to the focal curve. M. A. E.

251. *A List of Dwarf M Stars.* **W. J. Luyten.** (Roy. Astron. Soc., M.N. 86. pp. 48–50, Nov., 1925.)

252. *A Photometric Comparison of the Solar Coronas of* **1918** *and* **1925. J. Kunz** and **J. Stebbins.** (Astrophys. J. 62. pp. 114–127, Sept., 1925.)—The solar corona of January 24, 1925, was compared with three standard lamps by means of photo-electric cells. After allowance for the extinction of the earth's atmosphere, the total light of the corona is found to be nearly the same as measured on June 8, 1918 [see Abstract 853 (1919)], and there is no evidence of variation between sun-spot maximum and sun-spot minimum. The results are shown to be in good agreement with the bolometric measures of Abbot in 1908, and with the photo-electric measures of Briggs in 1922. The brightness of sky near the sun was found to decrease 5300-fold during totality in 1918, and 5500-fold in 1925. The results show the usefulness of the photo-electric cell for photometric measures of diffuse objects like the solar corona. AUTHORS.

253. *Measures of the Radiation of the Solar Corona of January* **24, 1925. H. T. Stetson** and **W. W. Coblentz.** (Astrophys. J. 62. pp. 128–138, Sept., 1925.)—Observations of radiation of the solar corona were made at Middletown, Connecticut, during the eclipse of January 24, 1925, by means of a reflecting telescope, vacuum thermopile of special design with fluorite window, a d'Arsonval galvanometer, and a glycerine cell for obtaining approximate water-cell transmission of the radiation. The mean of three series of measures indicated from 30 to 37 per cent. radiation transmitted by a 1-cm. cell of glycerine. The transmission of the glycerine was found to be practically identical with that of water under the same conditions. Proportionally more infra-red radiation from the corona than from the sun is indicated, in general accord with Abbot's results in 1908. A temperature of 3000° C. for the corona is tentatively suggested. The excess of infra-red now found is explained as due to difference in the screens employed. Cosmic dust and oxides of metals ejected from the sun are suggested as causes of this infra-red radiation. The supporting work of Nichols and Howes on luminescence of oxides is discussed.

AUTHORS.

254. *Solar Study at Meudon Observatory.* **H. Deslandres.** (Comptes Rendus, 181. pp. 583–587, Nov. 3, 1925.)—One form of solar radiation is luminous and accompanied by X or ultra-X rays, and is variable, influencing almost immediately terrestrial temperature and atmospheric pressure ; its variation being perhaps due to variable solar atmospheric absorption or to a special action of the faculae. The other form is corpuscular, causing auroræ and the disturbances of terrestrial magnetism. The author urges that all variable elements on sun or earth should be registered ; at Meudon the variations on the sun and of the magnetic needle are compared directly and simultaneously. Since the war the great spectroheliograph alone has been kept in constant use ; it can give the four layers (surface, reversing, middle and upper) with a diameter of 90 mm., and it can be transformed rapidly into a spectro-register of motions. It is proposed to make a synoptic chart for each solar rotation, giving the black filaments and the prominences, and completing the charts published by Zurich ; 30 such charts have been made. Plates are taken of the upper calcium layer (K_3), of the reversing layer (K_1), of the radial velocities on the disc (K_1,

K_2, K_3) to which one of the prominences is often joined, and of the upper hydrogen layer (H_a). In 1911, helicoidal prominences were discovered, giving a very feeble exterior solar magnetic field at the base of the corona of 10^{-7} gauss only, and corresponding to the same order of value found in 1922 by Störmer from the auroræ and the forms of the coronal jets. Calcium prominences are of positive ions with different conditions for large and small ones; in the former there is both an electric and a magnetic field; in the latter it is the magnetic field alone that gives to the jet its helicoidal form. A. S. D. M.

255. *Question of Day-to-Day Fluctuations in Derived Values of Solar Constant.* **C. F. Marvin.** (Monthly Weather Rev. 53. pp. 285–303, July, 1925.)—This preliminary analysis deals with short-period solar changes, and excludes both long-period changes and such as may occur when a sunspot passes across the central meridian of the sun's disc. It has six sections. The first deals with theoretical considerations and defines symbols and nomenclature: E_0 is the Smithsonian solar constant which includes errors of terrestrial origin; A_0 is a hybrid solar constant found by extrapolation at different air masses to zero air mass; σ is the standard deviation or *scatter*, etc. The three methods of measuring (pyrheliometry, bolometry, and pyranometry) are described. Sections II and III show how weak the statistical evidence still is for any appreciable changes in day-to-day solar intensity. The author insists that pyrheliometer measurements, including values of A_0, contain within themselves all the observational evidence of short-period variations, and that arbitrary empirical bolographical or pyranometer measures only add their own inherent errors to these parent data. In Section IV the consecutive solar constant values, 1902–1924, are charted, indicating atmospheric turbidity as the main cause of scatter. At one station in 18 months, 295 values show a scatter of only 0·30 per cent. for all causes of variation. Section V gives the 12-month period in solar constant values for the northern and southern hemispheres; almost without exception monthly mean values exhibit a very definite annual period unfailingly associated with summer and winter atmospheric states; therefore annual periodicity indicates terrestrial influence. In Section VI it is shown that either solar variation is non-existent or is relatively so small that it cannot be disentangled from the irregular larger variations in daily values due to errors of observation. A. S. D. M.

256. *Smithsonian Solar-Constant Values.* **H. H. Kimball.** (Monthly Weather Rev. 53. pp. 503–506, July, 1925.)—Abbot's determination of the mean solar-constant as 1·94 gramme-calories per minute per square centimetre [see Abstract 2116 (1923)] is generally accepted, though subject to a probable error not yet evaluated. The author considers what unavoidable errors of observation and reduction, and what of solar variability, are represented in day-to-day variations. He finds that errors in the fundamental pyrheliometric readings and in extrapolation to zero air mass will both be carried into day-to-day solar-constant values. He divides the 398 days of observation made at Montezuma and Harqua Hala, between Oct., 1920, and Nov., 1924, into three groups of which the first contains most of the secular variations in the solar constant, and finds that the correlation coefficient has significance only in this first group, and of the standard deviations at the twin stations (which are ± 0·013 and ± 0·017 gr. cal. respectively), only about ± 0·002 gr. cal. can be attributed to solar variability; for groups 2 and 3, not over ± 0·003 gr. cal. He concludes that the short-period solar variability, if it exists, falls within the limits of the probable error of the determinations. [See preceding Abstract.] A. S. D. M.

257. *Temperature Estimates of the Planet Mars.* **W. W. Coblentz.** (Bureau of Standards, Sci. Papers, No. 512. pp. 371–397, 1925.)—The present paper gives the results of an investigation of methods of estimating planetary temperatures, especially of Mars, from measurements obtained by newly designed radiometric instruments adapted to these problems. These temperature estimates are based upon radiometric measurements at the Lowell Observatory, Flagstaff, Arizona, during 24 nights extending over a period of 10 weeks from July to September, 1924. By means of a series of transmission screens of water, quartz, glass, and of fluorite the planetary radiation emanating from the irradiated surface of Mars was resolved into spectral components. The bright areas along the apparent centre of the disc have a temperature of − 10° to + 5° C., while the contiguous dark areas have a temperature of 10° to 20° C. During the period covered by these observations the temperature of the north polar region, where winter prevailed, remained fairly constant at − 70° C., while in the south polar region, where summer was advancing, the temperature increased to 10° C., or perhaps even higher, at the Martian summer solstice. AUTHOR.

258. *Problem of two Bodies with Diminishing Mass.* **W. D. MacMillan.** (Roy. Astron. Soc., M.N. 85. pp. 904–912, Oct., 1925.)—In the ordinary polar coordinate equations (1), $\ddot{r} - h^2/r^3 + k^2M/r^2 = 0$; $r^2\dot{\theta} = h$ (where h and k are respectively area and gravitational constant), the mass M is a decreasing function of the time, and it is assumed tha $M = M_0/\phi(t)$; $r = a\phi(t)$, where $\ddot{\phi} = c/\phi^3$; c being any constant. Th solution of the first equation in (1) is $\phi = \sqrt{1 + 2\mu t + \nu^2 t^2}$ where μ and ν are constants of integration. The differential equation which the function satisfies is given, and the author defines a new variable ρ, by $r = \rho \sin \alpha/\sin(\alpha - \tau)$, if $\mu < \nu$, and $r = \rho \sinh \alpha/\sinh(\alpha - \tau)$ if $\mu > \nu$, where $\tau = \int_0^t [\sqrt{\nu^2 - \mu^2}\,dt/(1 + 2\mu t + \nu^2 t^2)] = \sigma\nu \sin \alpha$; whence he derives the differential equations (2), $\dfrac{d^2\rho}{d\sigma^2} + \rho\nu^2 \sin^2 \alpha - \dfrac{h}{\rho^3} + \dfrac{k^2 M_0}{\rho^2} = 0$, $\rho^2 \dfrac{d\theta}{d\sigma} = h$; which are free from the independent variable explicitly but differ from the original equations (1) only by the addition of a force (attractive if $\sin^2 \alpha > 0$, repellent if $\sin^2 \alpha < 0$) which is proportional to the distance. He discusses the cases: $\mu = \nu$, $\alpha = 0$ and $\nu = 0$, $\mu \pm 0$: for which the above transformation is illusory; four solutions of (2) corresponding to $\mu < \nu$, $\mu > \nu$, $\mu = \nu$ and $\nu = 0$, $\mu \pm 0$, all of which curves are spiral having asymptotes except the fourth. He gives the general solutions of the differential equations and finds: If $\mu < \nu$, then the line of apsides of the ρ, θ orbit regresses, and contrariwise if $\mu > \nu$; also that the two apses move in different directions. If A be the semi-axis major and ϵ the eccentricity of the osculating Keplerian orbit, the eccentricity is essentially constant and the major axis is inversely proportional to the mass for any mass changes which can occur in a star. The sun radiates about $2/3 \times 10^{-13}$ part of its mass per year and if the sun were reduced to 1/1000 of its present mass, the formulæ, $A_0/A = M/M_0$, and $\epsilon = \epsilon_0$ would still be sensibly correct. The author refers briefly to the converse problem of increasing mass which gives also ϵ = constant, but A inversely proportional to M^3, and the period inversely porportional to M^5, thus accounting for spectroscopic binaries as in the final stage of a planetary system (the planets growing to starhood) and also possibly for the origin of Cepheids. [See Abstract 1237 (1918).] A. S. D. M.

259. *Relation between Masses and Distances of the Planets.* **M. Pierucci.** (N. Cimento, 2. pp. 325–331, July–Aug.–Sept., 1925.)—By analogy with the atomic structural quantity $-eE/2a$, a quantity termed for simplicity the "energy" of a planet may be written $W = -vMm/2a$ where v is the gravitation constant, a the semi-major axis of the orbit, m and M the masses of the planet and sun. Tabulating the quantity m/a, a simple relation appears to hold. If m/a for Jupiter be unity or $1/2^0 3^0 5^0$, all the values for m/a for the other planets are represented closely by expressions of the form $1/2^x 3^y 5^z$ where x, y, z are integers 0 to 5. The mean error is 0·82 % and would be much reduced if the doubtful data for Mercury were disregarded. A. Wh.

260. *Stellar Evolution.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 85. pp. 914–933, Oct., 1925.)—A mathematical investigation of the stability conditions in a star in which energy is being created at the expense of matter. Russell's hypothesis of this transformation being a function of the physical conditions cannot be supported, but the supposition of the "radio-active" type falls into line with what is known of stellar evolution. After a considerable mathematical discussion, it appears likely that a star begins as a super-giant with low surface temperature and possibly a variable. It becomes rapidly more completely ionised, the generation of energy falling off meanwhile. After passing through a maximum of ionisation, it contracts steadily till finally a form of instability sets in which is limited by the failure of the gas laws and the creation of a white dwarf. The enormous contraction (from densities of the order 10^{-7} to 10^{+5}) will account for the occurrence of many early binaries in the observed stage of development. A. Wh.

261. *Theorem of v. Zeipel on Radiative Equilibrium.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 85. pp. 933–935, Oct., 1925.)—A further reply to v. Zeipel's rejoinder [Abstract 2454 (1925)]. v. Zeipel gives as a solution of Schwarzschild's equation the expression :

$$I = \mu T^4 - \frac{d}{d\sigma}(\mu T^4) + \frac{d^2}{d\sigma^2}(\mu T^4) - e^{-\sigma}\int_0^{\sigma}\frac{d^3}{d\sigma'^3}[\mu T^4(\sigma')]\,d\sigma'$$
$$+ e^{-\sigma}\left[I_0 - \mu T^4 + \frac{d}{d\sigma}(\mu T^4) - \frac{d^2}{d\sigma^2}(\mu T^4)\right]_{\text{at surface}}$$

and contends that because $e^{-\sigma}$ is very small, the last two terms can be neglected. This does not seem to be justifiable, since the quantity in square brackets will be very great. It is also contended that v. Zeipel's "fundamental hypothesis" that the nature of the gas is constant over every level surface necessitates the constancy of gravitation over the surface. This will not in general be true. A. Wh.

262. *The Mass-Luminosity Relation.* **H. N. Russell.** (Roy. Astron. Soc., M.N. 85. pp. 935–939, Oct., 1925.)—It is shown that the expressions due to Eddington and Jeans are special cases of more general expressions when $\psi = 0$ and $l = 0$ respectively. There are reasons for believing that none of the expressions will represent the true state of affairs more than qualitatively. A. Wh.

263. *Forms and Development of Spiral and Allied Nebulæ.* **J. H. Reynolds.** (Roy. Astron. Soc., M.N. 85. pp. 1014–1020, Oct., 1925.)—From a study of photographs of spiral nebulæ, taken at Helwan and elsewhere, the author finds that the commencement of the curve is usually approximately of the logarithmic spiral form, but that the tangential angle of the curve with the radius vector varies considerably in different nebulæ and also along the arms of the same nebula. The angular development also varies much; but a development of less than half a revolution is very rare, and more than two revolutions in an actually spiral form are unknown. When two revolutions are nearly completed, great irregularities have invariably arisen, and the original curve, though still existing near the nucleus, has become much distorted. The bifurcations of one arm are usually more numerous than of the other. The massive spirals, with their large and bright amorphous nucleus and their frequently abnormal developments, do not show the spiral form so clearly as the filamentous. In some cases the spiral arms originate from the ends of a straight luminous band, and these forms have been called barred spirals. Jeans' theoretical work is in a general way confirmed by an examination of the various types of nebulæ, although no objects seem to have been photographed so far which represent the stage at which two nodules of matter are forming at opposite ends of the lenticular-shaped nucleus, and rudimentary spiral arms are very rarely found. The amount of development of the arms, taken in connection with the formation of condensations, is an indication of the age of a nebula; and it is possible that the faint nebulous spots which often appear in groups or "nests" are the remains of spiral nebulæ which have exhausted their nuclei and broken up. The paper is illustrated by photographs of nebulæ and a diagram representing six typical spiral nebulæ which form a sequence of progressive development and complexity. M. A. E.

264. *A Peep into Herschel's Workshop.* **W. H. Steavenson.** (Optical Soc., Trans. 26. 4. pp. 210–220, 1924–1925.)—A description is given of the results of a recent examination of such instruments and apparatus of the great astronomer as are still preserved at Slough, where the bulk of Herschel's optical and astronomical work was done. AUTHOR.

265. *Catalogue of Instruments Made and (or) Used by Sir William Herschel, as Preserved at Slough and Examined there in* 1924, *May and June.* **W. H. Steavenson.** (Optical Soc., Trans. 26. 4. pp. 221–238. 1924–1925.)—See preceding Abstract.

LIGHT.

266. *Total Reflection.* **C. V. Raman.** (Phil. Mag. 50. pp. 812–815, Oct., 1925.)—Photographs, five of which are reproduced in the paper, have been secured showing the penetration of the disturbance into the second medium which occurs by reason of the limitation of aperture when a pencil of light of finite width is incident at *more* than the critical angle on the boundary between the two media. A long train of diffraction bands can be seen in which the intensity of the successive bands diminishes relatively very slowly. The phenomenon can also be observed in the Lummer Plate. A simple explanation is offered of the results which fit in very well with the work of B. N. Chuckerbutti in the case in which the incidence is at *less* than the critical angle but do not support the considerations advanced by A. Schuster. W. H. Ge.

267. *A General Solution of the Vibrational Equation for an Astigmatic Beam.* **J. Picht.** (Ann. d. Physik, 77. 8. pp. 685–782, Oct., 1925.)—Debye has given solutions of the vibrational equation $\Delta\breve{u} + k^2\breve{u} = 0$ for the cases in which a focal point or a focal line exists [Abstract 94 (1910)]; the author deals with the general case, treating first an infinitely narrow beam with a caustic consisting of two straight focal lines in two planes passing through the central ray and perpendicular to one another; when one of the focal lines moves to infinity the problem becomes that of a cylindrical wave front. As a result of the formula arrived at for the general case, it appears that the intensity at any point can be obtained approximately by bringing the geometrical optical light-rays through it to interference, and that every ray about each of two focal surfaces undergoes an anomalous alteration of phase of $\pi/2$, so that in the case of a spherical wave, where the two focal surfaces dwindle to a common focal point, the anomalous alteration in phase becomes π. It is shown that the intensity at a point P, when the beam is not too widely opened, is to the first approximation proportional to the square of $\breve{u}_P$, where $\breve{u}_P$ depends on the field vectors E and H. Graphical representation of the intensity relations about the focal surfaces are given. H. N. A.

268. *The Colours of Colloidal Silver and Mercury.* **R. Feick.** (Ann. d. Physik, 77. 7. pp. 573–596, Oct., 1925.)—It has been found by different observers that the colours of colloidal silver do not agree with the Mie theory. The author has calculated the absorption for different diameters of the particles and different wave-lengths from the theory, and deduces the alterations of colour that should take place when the diameter increases. Since these do not agree with observation, it follows that Mie's theory in its simplest form is not sufficient to explain matters. Gans has shown that the form of the particles has a strong influence on the colour, and it seems certain that the silver particles are not spheres as is assumed in Mie's theory, but rather elongated or flattened bodies, ellipsoids or crystals. The radiation from and the absorption by colloidal mercury was calculated, and as far as can be judged by the qualitative observations so far made the results seem to agree with the actual relations.

Since the particles in this case are probably spherical, the conditions postulated by Mie are better fulfilled than in the case of silver, so that it appears that his theory is really adapted to form the basis of the solution of the complicated problem of the colours of colloids. H. N. A.

269. *Absorption in Excited Gases.* **K. W. Meissner.** (Phys. Zeits. 26. pp. 687–689; Disc., 689, Nov. 3, 1925. Paper read before the Deut. Physikertag, Danzig, Sept., 1925.)—By a suitable optical system, details of which are given in the paper, light from an emission tube is passed through a tube containing the excited gas. The absorption intensity is studied by photographic photometry and the bearing of the work on atomic structure is discussed. W. H. Ge.

270. *Anomalous Electric Double Refraction in Sodium Vapour.* **R. Ladenburg** and **H. Kopfermann.** (Preuss. Akad. Wiss. Berlin. Ber. 22. pp. 420–424 1925.)—The electric double-refraction, as well as the magnetic rotation, is approximately inversely proportional to the square of the wave-length difference $\lambda - \lambda_0$. In the line T_1 the π and σ components are equally displaced while in D_2 there is a σ_1 component equally displaced with the π component and an σ_2 component hardly displaced at all. A. D.

271. *A New Method of Distinction between Fine and Cultivated Pearls.* **C. Chilowsky** and **F. Perrin.** (Comptes Rendus, 181. pp. 604–605, Nov. 3, 1925.)—Advantage is taken of the fact that when a layer of pearly substance is strongly illuminated at one point the light is transmitted mainly through the layer itself, very little light passing to contiguous layers. A combination of small mirrors at 45°—which, in conjunction with a suitably designed microscope, is designated by the name "endoscope"—is inserted in a hole pierced axially through the pearl and a powerful illuminant focused so as to illuminate a point in the interior of the hole. The presence or absence of a symmetrically situated bright point indicates respectively concentricity of the layers of the genuine pearl or the plane parallel structure of the mother-of-pearl nucleus of the cultivated pearl. A. B. C. L.

272. *Brightness Distribution over Cylindrical Surfaces.* **P. Wolmeringer.** (Zeits. f. Physik, 34. 2–3. pp. 184–215, 1925.)—Given the diffusing characteristics of a material, it is possible to calculate the brightness of different parts of a cylindrical surface covered with this material and illuminated by a parallel beam of light. The author has done this for a number of substances and has compared the results with experimental values. J. W. T. W.

273. *Photometric Efficiency of Optical Apparatus.* **A. Blondel.** (Comptes Rendus, 181. pp. 449–453, Oct. 12, 1925.)—Deals with the use of a recently described [see Abstract 2480 (1925)] universal portable photometer in the measurement of the photometric efficiency of photographic lenses, telescopes, microscopes and projectors. The necessary theory and procedure are given. W. H. Ge.

274. *On the Reliability of the Records of Registration Photometers with Photo-Cells. A Criticism of a Recent Publication by Rosenberg.* **P. P.**

Koch. (Zeits. Instrumentenk. 45. pp. 494–495, Oct., 1925.)—In a recent publication by Rosenberg [see Abstract 2257 (1925)] it is asserted that the fatigue and recovery processes of photo-cells render them not too reliable for registration photometers. The present author briefly asserts, on the contrary, to have established their remarkable freedom from fluctuation. Other sources of error are discussed and Rosenberg's variations explained.
H. H. Ho.

275. *Device for Centering a Crystal on a Spectrometer.* **L. Biermass.** (Zeits. Instrumentenk. 45. pp. 483–485, Oct., 1925.)—The method usually adopted for the centering of the crystal in a Siegbahn X-ray spectrometer was found to lead to errors in the measured wave-length of some thousandths of an Ångström unit. The present paper describes a simple electrical contact device which enables the centering to be made much more accurately.
A. A. D.

276. *Use of Light Filters in Polarimetry.* **H. Schulz.** (Zeits. Instrumentenk. 45. pp. 468–470, Oct., 1925.)—The author lays down the conditions governing the use of coloured filters for polarimetry. It is pointed out that a filter with close wave-lengths limits has a low transmission and therefore demands a half-shade angle which is not too small. The usual convention being to give the specific rotation for sodium light, it is necessary to use a filter with maximum transmission in the neighbourhood of 589 $m\mu$. The colour discrimination of the eye in this region of the spectrum is high, so that a narrower transmission band is required than would be necessary for other parts of the spectrum. The transmission is therefore correspondingly reduced.
J. W. T. W.

277. *Microscopic Problems.* **R. Gans.** (Ann. d. Physik, 78. 1. pp. 1–34, Nov., 1925.)—This paper deals with some of the fundamental microscopic problems from the standpoint of Maxwell's theory so far as this is possible, and otherwise by means of practical approximations. The inadequacy of the older views concerning light motion or light excitation does not appear to have been entirely remedied by the introduction by Lummer and Reiche of rotating dipoles, while difficulties also occur with polarisation relations and prevalent ideas concerning the absolute intensity of light. § 1 investigates the optical field of an illuminated particle. § 2 deals with the image through a microscope objective under certain limitations of aperture. § 3 examines the case where the illuminating beam oscillates in the plane of incidence. § 4 gives an analytical derivation of the Siedentopf azimuth effect which plays an important rôle in the ultramicroscopic methods for determination of form, and indicates in § 5 how certain conclusions can be drawn as to the true dimensions of the observed body. § 6 considers the breadth of linear objects. Although the same problem was treated theoretically by Michelson in 1890 for astronomical purposes, the author points out the essential difference that stellar light is incoherent, whereas in the microscopy of non self-illumination the light is coherent and of known character. The paper includes numerous diagrams and copious data.
H. H. Ho.

278. *The Pellin-Broca Prism.* **G. Guadet.** (Rev. d'Optique, 4. pp. 493–506, Oct., 1925.)—The author contends that the total reflection prism, used as a dispersion apparatus with constant deviation, was first

V.2
192

described in 1899 by P. Pellin and A. Broca, who had perceived all its properties and to whom the original design belongs. [See Abstract 1480 (1899).] The theory of the method is developed in a series of mathematical propositions which leads to rigorous conditions for the use of the apparatus, the prism moving along a circular arc which in turn rolls on the arc of a circle belonging to the dispersion system. The prior claims of Abbé and Boltsch to the idea are discussed. The former committed an error in calculation which had the effect of hiding the idea of constant deviation, while the latter, by having the faces of incidence and emergence in the prism perpendicular, prevented the practical development of the idea. R. S. R.

279. *Reply to a Criticism by H. Schulz on Calcite Lenses as Polarisers.* **W. Schütz.** (Zeits. f. Physik, 34. 5–7. pp. 545–546, 1925.)—The author [Abstract 2067 (1925)] proposed a lens system of calcite for obtaining polarised beams of high luminosity throughout the spectrum. H. Schulz [Abstract 2258 (1925)] criticised their use adversely. The present note is the author's reply to these criticisms, vindicating his position. S. G. B.

280. *The Optical Properties of Amethyst Quartz.* **C. V. Raman** and **K. Banerji.** (Optical Soc., Trans. 26. 5. pp. 289–292, 1924–1925.)—Circularly polarised waves of light in passing through a section-plate of amethyst quartz, would obviously be retarded unequally in the alternate laminæ having right- and left-handed optical activities. Diffraction effects must therefore arise, and these can actually be observed even in almost colourless varieties of the quartz. The section-plate behaves in effect as a phase-change diffraction grating, and the question of the visibility of its structure with and without the aid of polarisers and analysers is discussed in the light of Abbé's theory of microscopic vision. AUTHORS.

281. *Light Standard for Photographic Sensitometry.* **C. Fabry.** (Soc. Franç. Élect., Supplement to Bull. No. 50. pp. 27–32, Oct., 1925.)—Describes the proposals before the International Photographic Congress in Paris, *viz.* (*a*) to take as the photographic unit the intensity of a source giving black-body radiation at a colour temperature of 2360° K. and having a visual intensity of 1 international candle, or (*b*) to take the same type of source screened with a colour filter so as to give light of the same visual colour as daylight. The former proposition was provisionally adopted. The author points out that before the second proposal can be adopted with safety it will be necessary to study the spectral transmission curve of the filter combination proposed ($CuSO_4$; ammoniacal solution of $CuSO_4$), particularly in the short wave-lengths. J. W. T. W.

282. *A Non-Intermittent Sensitometer (Time-Scale Exposure Machine) with Clock-Controlled Motor Drive.* **R. Davis.** (Bureau of Standards, Sci. Papers, No. 511. pp. 345–370, 1925.)—The work of the Bureau of Standards, in studying photographic materials and processes, has a threefold objective, namely, an inquiry regarding the nature and causes of photographic action and phenomena, the application of photography to scientific research, and the standardisation of the methods and procedure for testing photographic materials. The sensitometer described in this paper is a special instrument designed for both research and testing purposes, and has, therefore, a more extended exposure range than is necessary for testing purposes. It is a sector-wheel machine in which the entire exposure takes place during one revolution. The sector wheel may be run at a wide range of speeds of from 480 to 0·0586 r.p.m. This speed range is covered in steps varying by powers of two, and is obtained by means of change gears that connect the sector-wheel shaft with either of two other shafts which are driven through worms and gears by a constant speed motor at fixed, but different speeds. A new arrangement of the apertures in the sector wheel is used. The principal details of the construction and calibration of the sector wheels are given. AUTHOR.

283. *Stimulation of Optical Activity in Silver.* **H. Zocher** and **K. Coper.** (Preuss. Akad. Wiss. Berlin, Ber. 23. pp. 426–431, 1925.)—An inquiry based upon the observed circular asymmetry in certain organic molecules as extended to inorganic molecules. Optical activity found produced in silver photochloride films by the action of circularly polarised light. The effect is due to the silver molecules re-arranged through a difference in the absorption of the two components of the circularly polarised light, with a consequent difference in the photoelectric effect in two directions. A. D.

284. *Desensitisers.* **H. Stammreich** and **H. Thirring.** (Zeits. Wiss. Phot. 23. pp. 363–367, Oct., 1925.)—The inquiry was whether desensitisers acted only on particular regions of the spectrum. The desensitisers tried were methyl green, Nile blue 2B, safranine, phenosafranine, tetramethyl safranine, flavindulin, neutral red, rosinduline 2G, and indulin scarlet. They gave the greatest proportional desensitisation in the blue and ultra-violet, even with sensitised plates; the proper sensitiveness of the silver bromide is thus reduced. Tetramethyl safranine, however, worked uniformly over the whole field. Some of them—notably methyl green—act as sensitisers for the less refrangible rays as well as desensitisers for blue and ultra-violet. A. D.

285. *Solarisation of the Photographic Plate.* **J. M. Eder.** (Zeits. Wiss. Phot. 23. pp. 377–382 Oct., 1925.)—The peculiar phenomenon, whereby in place of the normal negative a direct positive appears with an excessive lighting of the photographic plate, has been the subject of much investigation. The work of Abney, Lüppo-Cramer and others is discussed, but the recent work of Arens receives most attention. It is concluded that the claim of Arens, that with bromide of silver gelatine plates impregnated with nitrite the direct photochemical blackening may be so intense that it conceals the solarisation, does not correspond with the experimentally established facts of the usual solarisation phenomena, and that conclusions based on it therefore lose their value. A. E. G.

286. *The Scattering of Light by Liquid Boundaries and its Relation to Surface Tension. Part III.* **C. V. Raman** and **L. A. Ramdas.** (Roy. Soc., Proc. 109. pp. 272–279, Oct. 1, 1925.)—A continuation of previous work. [Abstract 2677 (1925).] A table is given showing the comparison of the brightness of surface scattering and internal scattering of light by clean water and twenty-eight other liquids. The effects of oil contaminations on the surface-opalescence of water were determined and for oleic acid, poured on in such quantity as just sufficient to stop camphor movements, the increase in intensity of surface opalescence is about 100 %.

The phenomenon is shown by photographs. The special polarisation phenomena observed and the variation of surface opalescence with temperature are described for liquid carbon dioxide. Observations are recorded of the interfacial scattering by the boundaries between the two components of a binary mixture of carbon disulphide and methyl alcohol, and the effect of raising the temperature to the critical solution point. The papers are experimental throughout. S. G. B.

287. *Nature of Photo Haloids and Similar Substances.* **R. Feick** and **K. Schaum.** (Zeits. Wiss. Phot. 23. pp. 389–412, Nov., 1925.)—It is found possible to use the dielectric constants of metals in investigations of the metal contents of photo haloids and similar substances. In the cases of thallium chloride, silver chloride and lead bromide the dielectric constants measured by the second Drude method show a considerable rise with increase of blackening due to light. A. E. G.

288. *Fluorescence Radiation of Nitrogen.* **O. Oldenberg.** (Nat. Acad. Sci., Proc. 11. pp. 595–597, Oct., 1925.)—The fluorescent radiation of nitrogen has been excited in a similar manner to Wood's resonance spectrum of iodine. In this case the extreme ultra-violet is necessary for excitation and, therefore, the exciting discharge must be in the same vessel as the fluorescent gas. The light-source, a condensed spark, was placed in a glass tube with lateral opening and disturbing electric currents were prevented by shining the light into a Faraday cage and by a strong magnetic field parallel to the spark. The fluorescent spectrum was photographed in eighteen hours using a glass spectrograph working at F/2·7. Some of the bands observed are known to be due to ionised molecules, the probable origin of which is discussed. F. S.

289. *Polarisation of Resonance Radiation in Magnetic Field.* **E. Gaviola** and **P. Pringsheim.** (Zeits. f. Physik, 34. 1. pp. 1–10, 1925.)—If the exciting rays and those which serve for observation be not exactly parallel, the observed polarisation of mercury resonance radiation is less than that predicted by theory; the difference is greater when H is perpendicular to E than when H is parallel to E; this explains the apparent anomalies hitherto met with. For the D resonance radiation the relation between the polarisation p_1 for E is parallel to H and the polarisation p_{11} for E is perpendicular to H is independent of the relation between the intensities of the Zeeman components of D_2 and also of the influence of any depolarising action and of the proportion of D in the total radiation; so that if p_1 be found, p_{11} is determinate. The apparent defect of value of p_{11} in Na-fluorescence is similarly due to the angular divergences of the primary and secondary bundles of rays. A. D.

290. *Fluctuations of Diffraction-Spectra.* **E. Buchwald.** (Phys. Zeits. 26. pp. 672–675; Disc., 675, Nov. 3, 1925. Paper read before the Deut. Physikertag, Danzig, Sept., 1925.)—A mathematical investigation of the variations in intensity in diffraction spectra, *e.g.* in X-ray spectrograms. The diffraction maxima stand out sharply against a continuous background, which is stronger the more violently are the crystal-particles disturbed from their positions of rest by the heat-motion. A particular case is worked out on classical theory; N slits are considered, having a particular grating constant, and the slit interval is allowed to fluctuate about a mean value so that instead of being regularly distributed, the slits have irregular intervals. The consequent intensity distribution among the maxima and minima is then calculated. The central maximum is unaffected by the fluctuations. *First Minima.*—The mean square of the fluctuations equals the mean square of the intensity. *Chief Maxima.*—The mean square of the fluctuation is greater than for the neighbouring minima. *Secondary Maxima.*—As for the chief maxima, but with a more complicated expression. The results compared satisfactorily with experiment. A. C. M.

291. *The Dispersions of Potassium and Sodium Chlorides.* **K. F. Herzfeld** and **K. L. Wolf.** (Ann. d. Physik, 78. 1. pp. 35–36, Nov., 1925.)—In this paper the authors investigate the anticipated connection between the dispersions of the alkali halides and those of the inert gases. This involves the electronic numbers and wave-lengths of the absorption lines. The connection between the formulæ $(n^2 - 1)/(n^2 + 2)$ and $n^2 - 1$ for substances of several special frequencies is first considered, following which formulæ are derived for sodium and potassium chlorides. These contain 3 terms, one referring to the kation and the others to the anion. The electronic numbers for the chlorine ion are very nearly equal to those of the similarly constructed argon atom. The two absorptions due to the chlorine ion are explained by a centre of continuous absorption and a resonance line. The continuous absorption, as in the case of the inert gases, is regarded as due to the complete detachment of an electron. The discussion of these wave-lengths shows that for the detachment of an electron not only the work against the attraction of the particular chlorine ion (electronic affinity) has to be rendered, but also the work against the attraction due to the excess charges at the other lattice points (Coulomb fraction of the lattice energy). Based on these considerations the wave-lengths are calculated with good approximation. Conversely from the wave-lengths of the kation the ionisation tensions belonging to k^+ and Na^+ may be calculated. H. H. Ho.

292. *Band Spectra.* **H. Deslandres.** (Comptes Rendus, 181. pp. 410–412, Oct. 5, 1925.)—This forms the conclusion to the previous paper [see Abstract 94 (1926)], and it is pointed out that the infra-red band spectrum can be represented by the formula $\nu = qd_1/rs \pm q'd_1/r's'$, in which d_1 is the constant 1062·5, s the number of atoms in the molecule, s' the number of valence electrons, and q, r, q', r' are integers. The first term represents the principal band, and the second term subsidiary bands which appear with greater dispersion. The first term has been shown in previous papers to apply in twenty infra-red spectra. Further consideration is then given to the observation that a number of the stronger lines in the line-spectra of simple bodies can be represented as multiples of the constant, 1062·5. F. S.

293. *Zeeman-Effect on Helium Bands.* **W. E. Curtis** and **W. Jevons.** (Nature, 116. pp. 746–747, Nov. 21, 1925.)—Recently, Nicholson [Abstract 91 (1926)] pointed out the importance of investigating the effect of a magnetic field on the so-called doublet bands of He, and gave reasons for expecting that these particular bands should be subject to a Zeeman-effect of the same general character as in the case of atomic line series. The authors had already completed the experimental part of such an investigation, of which they here give a preliminary account. The band-lines exhibit no Zeeman-effect of a "normal" order of magnitude except in the case of the first member of each of the three branches constituting the band, namely, Q(1), R′(1) and P(2). These are broadened, but not resolved into components as are the neighbouring He lines λλ 4713, 4471 and 4388. The effect of the magnetic field on the molecule is largely determined by the state of rotation of the latter, being relatively small for the higher speeds of rotation. A. D.

294. *New Results concerning the Fine Structure of Spectral Lines.* **E. Gehrcke.** (Phys. Zeits. 26. pp. 675–677; Disc., 677, Nov. 3, 1925. Paper read before the Deut. Physikertag., Danzig, Sept., 1925.)—A continuation of previous work [Abstract 1478 (1924)]. Experimental results of the separations and relative intensities of components of H_α. It is shown that at a pressure of 0·1 mm. of mercury in the discharge tube, H_{α_1} is weaker than H_{α_2}, whereas at a few millimetres' pressure the reverse is the case. Again, if the pressure is lower and the diameter of the tube not too small, the two components have approximately the same intensities. The separation of H_{α_1} and H_{α_2} is given as $\Delta\lambda = 0\cdot128$ Å.U., or $\Delta\nu = 0\cdot296$ cm.$^{-1}$. The results are not in exact agreement with the Sommerfeld predictions. The fine structure of Helium λ 4686 has again been investigated by Leo, and again complete agreement is not obtained, though three components show good agreement. Bowen and Millikan have found similar deviations for Mg_{II} and Al_{III} and S_{VI}.

In the *Discussion,* **Paschen** emphasised the importance of the appearance of the component IIIα, which is "forbidden" in Sommerfeld's theory. **Joos** and **Sommerfeld** discussed the intensity of III*c*, while **Smekal** pointed out the interest of comparison of results obtained, using a grating and a Lummer-Gehrcke plate. **Gehrcke** pointed out that the spark spectrum of helium contains a band line at 4685·308 which has nothing to do with 4686, but was used by Paschen for the measurement of the constants. W. V. M.

295. *Thin Metallic Films.* **C. Müller.** (Preuss. Akad. Wiss. Berlin, Ber. 25. pp. 464–470, 1925. From the Reichsanstalt.)—Bare films of Ni, Au, Pt, Ag, Fe made at the Reichsanstalt, down to a thickness of 1 × 10^{-6} cm. A film of, say, gold is electrolytically deposited on a thin film of electrolytic metal, say copper; then a symmetrical thickness of copper is deposited electrolytically on the gold; then the two layers of copper are etched away, leaving the gold film; the products are very transparent and strong. Spectrographical investigation given, with plates. A. D.

296. *Nickel Spectrum.* **K. Bechert.** (Ann. d. Physik, 77. 5. pp. 537–559, 1925.)—A quintet system is recognised in the nickel spectrum, and singlet-quintet combinations are also found. The rule for *j* is completely observed. Discussion of the level scheme for Ni, and comparison with Fe and Co; regular distribution of the terms, alternations of multipliers. Reference is made to the application of Heisenberg's method. A. D.

297. *The Spectrum of Potassium at Low Voltages.* **F. H. Newman.** (Phil. Mag. 50. pp. 796–803, Oct., 1925.)—A continuation of previous work on sodium [Abstract 2294 (1925)], and an analogous investigation.

Spectrograms of the radiation from potassium at voltages of 1·9, 3·3, 3·7, 3·9 and 4·4 volts show the step-by-step production of important series. The first doublet of the principal series appears at 1·9 volts, a fair agreement with calculated values. A complete series of results is given below.

Series.	Exciting Voltage.	
	Experimental.	Calculated.
$1\sigma - 1\pi$	1·9	1·61
$1\pi - 2\sigma$	—	2·59
$1\pi - 2\delta$	—	2·66
$1\sigma - 2\pi$	3·3	3·05
$1\pi - 3\delta$	3·7	3·38
$1\pi - 3\sigma$	3·7	3·39
$1\sigma - 3\pi$	3·9	3·58
complete arc	4·4	4·32

The observations show that the displacement from 1σ to $m\pi$ can take place by electronic collision, and a step-by-step emission results as the energy of the bombarding electron is raised to a value slightly exceeding that calculated from the quantum relation. W. V. M.

298. *Series in the Arc Spectrum of Lead.* **H. Gieseler** and **W. Grotrian.** (Zeits. f. Physik, 34. 5–7. pp. 374–388, 1925.)—The series found by Thorsen in this spectrum have been extended and higher members of his series measured. The lines have been remeasured, and terms recalculated from the more exact measurements. In addition, new series have been found; two are the diffuse and the sharp subordinate series belonging to a common P_0 term, while two others were thought to be *pf* combinations, and led to the deduction of Bergmann terms. Very many new lines were obtained; this was rendered possible by the use of a source of light specially arranged to enhance higher members of series. The most favourable conditions are considered in detail which can help to privilege the higher members of series. Since outer orbits are concerned, the pressure must be low to avoid collisions. The loss in luminosity thus caused must be compensated by powerful excitation, and therefore a plentiful source of electrons as kathode. End-on observation in a long tube at low pressure with a hot-kathode is recommended, precautions to eliminate tap-grease being taken. A. C. M.

299. *The Arc Spectrum of Titanium from* $\lambda = 7496$ *to* $\lambda = 2273$. **K. Behner.** (Zeits. Wiss. Phot. 23. pp. 325–342, Oct., 1925.)—The paper consists largely of a catalogue of some 1330 lines in the arc spectrum of titanium in International units, and is unsuitable for abstraction. W. V. M.

300. *Fine Structure, Absorption and Zeeman-Effect of the* 2536 *Mercury Line.* **R. W. Wood.** (Phil. Mag. 50. pp. 761–774, Oct., 1925.)—The technique of adjusting two crossed Lummer plates of quartz for photography of a line in the ultra-violet is first described. In order to obtain the true structure of the line in question, the mercury lamp had to be operated on minimum current and the discharge pressed against the wall of the tube by a magnetic field. The line consists of five components of nearly equal intensity, each of which is doubled by absorption without the precautions noted. With increasing absorption the components broaden and adjacent lines close up so that an appearance consisting of six or seven lines can be obtained. Nitrogen at 3 cm. pressure is equivalent to a rise of 20° C. in temperature of mercury vapour, and increases absorption tenfold. Various difficulties were experienced in connection with the Zeeman-effect, and to eliminate these special discharge tubes will have to be designed. **F. S.**

301. *Optical Excitation of the Mercury Spectrum.* **R. W. Wood.** (Phil. Mag. 50. pp. 774–796, Oct., 1925.)—This is a continuation of previous work done to confirm Bohr's theory of the absorption and emission of light by metallic vapours. The resonance tube could be illuminated by two mercury vapour lamps, and by the use of appropriate filters the exciting light can be confined to any one wave-length in addition to the 2536 resonance line. The change of intensity caused by using a magnetic field with the lamp giving 2536 are described, the increase of intensity being due to decreased absorption of 2536. The effect of the introduction of filters of bromine and chlorine is described in detail, and also that due to the introduction of nitrogen, carbon monoxide, or helium into the resonance tube. **F. S.**

302. *Determination of the Terms of the Mercury-Hydrogen Bands.* **H. Ludloff.** (Zeits. f. Physik, 34. 5–7. pp. 485–495, 1925.)—In a recent paper Hulthén [Abstract 1896 (1925)] has concluded that his measurements were not in agreement with the previous analysis by Kratzer and has come to the conclusion also that the theoretical treatment was not applicable to this and analogous bands. In the present paper the author has shown how the determination of the terms may be carried out according to Kratzer's scheme, and deduced various results concerning the structure of the Hg-H molecule. **W. V. M.**

303. *Excitation of the Spectra of Hydrogen by Electronic Impact.* **P. M. S. Blackett** and **J. Franck.** (Zeits. f. Physik, 34. 5–7. pp. 389–401, 1925.)—Experiments are described which show that electrons possessing a certain kinetic energy may dissociate a hydrogen molecule into a normal and an excited atom during a single impact. Various other possibilities, such as the production of free atoms during the discharge, are discussed and shown to be untenable. Careful observations on the fine structure of the Balmer H_α line show that the Doppler width corresponding to the conditions employed is greater than that observed during the emission from free atoms. The effect is explained by consideration of the relative velocities with which the products of dissociation recede from each other. Discussion is also given of the emission of the continuous hydrogen spectrum. Photographs showing fine structure under various conditions of discharge are given. **W. V. M.**

304. *The Fine Structure of Hydrogen Lines.* **G. Hansen.** (Phys. Zeits. 26. pp. 678–680; Disc., 680, Nov. 3, 1925. Paper read before the

Deut. Physikertag, Danzig, Sept., 1925.)—The paper describes the results of more accurate determinations of the separations and relative intensities of H_α components. A glass tube 1·5 metres long, 9·7 mm. width, and cooled in liquid air, served as source of light. A Lummer-Gehrcke plate is employed, and the photographs measured with a registering photometer. At pressures between 0·2 and 0·015 mm., and current densities between 0·2 and 0·04 amp./cm.^{2}, the results show the same characters. The intensity $I\kappa/I\epsilon$ of the Doublet group is dependent on pressure and current density. From $\alpha \rightarrow \beta \rightarrow \gamma$ an increase in $\Delta\nu$ is observed. The results are in accord with the theory. **Gehrcke,** in the *Discussion*, says that the values of $\Delta\nu$ are smaller than would be expected. This may, according to Hansen, be corrected with the non-linear dispersion of the Lummer-Gehrcke plate. W. V. M.

305. *Measurements of "Negative" Oxygen Bands in the Visible Region.* **F. Holland.** (Zeits. Wiss. Phot. 23. pp. 342–363, Oct., 1925.)—The paper gives the results of measurements of three groups of negative bands in the regions (*a*) 6226–5807, (*b*) 5644–5509, (*c*) 5295–5196. A description of the discharge tube is given, and a discussion of the errors of measurement. The paper consists largely of tabulated wave-lengths. W. V. M.

306. *The Infra-red Absorption Bands of Methane.* **J. P. Cooley.** (Astrophys. J. 62. pp. 73–83, Sept., 1925.)—Previous investigations on methane have shown three absorption regions which Coblentz places at 7·7 μ, 3·31 μ, and 2·35 μ. By using the higher resolving-power of a grating spectrometer all these have been partially resolved into lines. About fifty lines in the region of 3·31 μ were measured and arranged in positive and negative series. Between these, and masking part of the negative or longer wave-length series, lies a narrow region of intense absorption corresponding to the zero branch. Here the lines are too closely packed to be resolved, but the complex structure is indicated by a large shift of the maximum absorption when the thickness of the layer of gas is changed. The band at 7·7 μ is similar to the one at 3·31 μ. Twelve lines in the negative series and eighteen in the positive series have been measured, but again in the zero branch no fine structure appears. The resolving-power of the apparatus was insufficient to show much detail in the band at 2·35 μ. In the positive and negative branches near 7·7 μ the frequency difference between adjacent lines is 9·77 cm.$^{-1}$, and near 3·31 μ it is 5·41 cm.$^{-1}$. A faint band of twelve lines near 3·5 μ has a frequency difference approximating 15·3 cm.$^{-1}$. AUTHOR.

307. *The Molecular Structure and Infra-red Spectrum of Methane.* **D. M. Dennison.** (Astrophys. J. 62. pp. 84–103, Sept., 1925.)—An attempt is made to treat the molecule of methane from the standpoint of the quantum theory and to determine the frequencies of radiation which it may absorb or emit. The assumption is made that in the normal state the four hydrogen nuclei lie at the corners of a regular tetrahedron, while the carbon nucleus lies at the centre. It is further assumed that following an infinitesimal displacement of the nuclei the potential energy depends upon the squares of the displacements along the lines between the nuclei. The model yields four normal frequencies, ν_1, ν_2, ν_3, and ν_4, which through the use of two undetermined constants may be made to coincide quite closely with the four fundamental frequencies found experimentally by J. P. Cooley. By studying the change of the electric moment it is possible to predict the relative intensities of these four fundamental bands. The agreement between the theoretical and experimental intensities is quite satisfactory. Cooley has found that the spacing of the fine structure lines of the band to be correlated with the frequency v_4 is approximately half the corresponding spacing between the lines of the v^3 band. In the present paper it is shown that such a phenomenon seems capable of being explained under the assumption that the molecule of methane possesses a resultant electronic angular momentum fixed in direction in the molecule of amount $\frac{1}{2}(h/2\pi)$. AUTHOR.

308. *The Blackening Law for Homogeneous Röntgen Rays.* **W. Busse.** (Zeits. f. Physik, 34. 1. pp. 11–14, 1925.)—The time curves up to full blackening for filtered molybdenum radiation and spectrum of tungsten radiation. The straight ascent found by Glocker and Traub for heterogeneous and practically homogeneous X-rays and surfaces illuminated applies also to completely homogeneous radiations and linear illuminations. The curved form found by Jönsson [Abstract 2099 (1924)] must be due to the different mode of development. A. D.

309. *X-Ray Spectra from a Ruled Grating.* **A. H. Compton** and **R. L. Doan.** (Nat. Acad. Sci., Proc. 11. pp. 598–601, Oct., 1925.)—A considerable amount of X-ray energy is reflected from speculum within the critical angle for total reflection [see Abstract 2198 (1923)], which for wave-lengths less than 1·6 Å. is about 25 minutes of arc. A grating, with space of about 2×10^{-3} cm. and ruled rather lightly, was used, and spectra up to the third order obtained with MoK_α, which was isolated by a calcite crystal. The deduced wave-length, *viz.* $0 \cdot 707 \pm 0 \cdot 003$ Å., is well within experimental error. F. S.

310. *The Reflection of X-Rays by Potassium Bromide Crystals.* **H. Kulenkampff.** (Phys. Zeits. 26. pp. 657–658, Oct. 13, 1925.)—Describes some observations made in the spring of 1924, which confirm the results of Armstrong, Duane and Havighurst, who have recently found [see Abstract 1907 (1925)] that the results of Duane and others, who have claimed that various alkali haloid crystals, when used in obtaining an X-ray spectrum by the ionisation method, gave the lines of the *k* series of the halogen atom, were due to imperfections or irregularities in the crystals used. The author has obtained photographs, using both the rotating crystal method and the Seemann knife-edge method; neither method gave the bromine *k* lines. The fact that tungsten lines of very small intensity showed up on the photographs in the region where the bromine lines might be expected, shows that the time of exposure and other conditions were satisfactory, and that no selective reflection of measurable intensity takes place from bromine. H. N. A.

311. *The Asymmetry of the Electron Discharge Produced by X-Rays. II.* **W. Seitz.** (Phys. Zeits. 26. pp. 610–615, Oct. 3, 1925.)—In a previous paper [see Abstract 580 (1925)] the author has described a method of photographing the magnetic spectra of the electrons produced in a metal foil by a perpendicular beam of X-rays, and sent out in the forward and the backward directions; and determining the relation between the ratio of the two electron radiations and the velocity of the electrons. To keep down the time of exposure a rather broad X-ray beam was employed (1 mm.), and single lines were not visible in the photographs, so that it was not possible to decide whether the electrons from the K and L layers showed this asymmetry in intensity distribution, or whether it was confined to the electrons from the outer layers. The experiments have now been repeated with a 0·6-mm. slit, and extended to other metal foils. The curves of blackening of the plates were recorded photographically by means of a self-registering photometer, with a Moll thermophile and galvanometer, and show a number of sharp saw-teeth, which can be identified as being due to definite electrons, such as $K\alpha(Ag) - K(Cu)$ (silver antikathode, copper foil), which are liberated from the K layer of copper. by the $K\alpha$ rays of silver. It appears that all the bands and steps of blackening, corresponding to electrons which are liberated by primary X-rays, are much more intense and sharper on the exit-side plate than on the other, some weak bands appearing only on the former; bands corresponding to electrons produced by secondary homogeneous X-radiation, originating in the metal foil, are more intense on the entrance plate, probably because the primary X-rays are weakened in passing through the foil, in spite of its thinness, and so the secondary X-radiation is stronger on the entrance than on the exit side. H. N. A.

312. *X-Ray Scattering.* **R. D. Bennett.** (Nat. Acad. Sci., Proc. 11. pp. 601–602, Oct., 1925.)—This is an attempt to test the theory of X-ray scattering worked out by Compton and Debye. A number of Geiger counters were mounted on arms pivoted about the centre of a chamber which could be exhausted. Rays from a Coolidge tube at 140 and 200 kv. were used, and both solid and gaseous scattering targets employed. The results so far obtained do not give a satisfactory test of the quantum theory of scattering. F. S.

RADIO-ACTIVITY.

313. *The Radio-activity of Potassium, Rubidium, and other Elements.* **W. D. Harkins** and **W. G. Guy.** (Nat. Acad. Sci., Proc. 11. pp. 628–630, Oct., 1925.)—A very large ionisation chamber was employed to contain the salt investigated, and before this was introduced the natural leak of the chamber was compensated by balancing it against a smaller chamber containing uranium oxide covered with aluminium foil, which kept back the α-radiation. The shift of the electrometer mirror was practically zero for from two to five minutes, while the introduction of a potassium salt deflected the spot at the rate of 300 to 35 divisions per minute. The practical absence of β-ray activity was proved for a number of salts and elements. The coefficient of absorption of the radiation from rubidium salts is from ten to fifteen times larger than that of potassium salts, and the rubidium radiation is probably more complex. The ratio of the activities of Rb and K is 1·39 : 1·00. It is suggested that the activity of potassium is the property of one of the isotopes, and different possibilities are discussed. H. N. A.

314. *Mass Determination of H-Particles.* **G. Stetter.** (Zeits. f. Physik, 34. 2–3. pp. 158–177, 1925.)—Employing an apparatus similar in general arrangement to the Aston mass-spectrograph, the author has determined the e/m value of hydrogen particles emitted from paraffin wax when bombarded by α-particles from RaC or RaEm in equilibrium. The photographic plate of the Aston spectrograph is replaced by a ZnS screen and counting microscope and a modified form of slit is used. As a result of the experiments it has been found that the mass of the so-called H-particles is identical with that of the hydrogen atom within an accuracy of ± 3 %. A. B. W.

315. *The Photographic Action of H-Rays from Paraffin and Aluminium.* **Marietta Blau.** (Zeits. f. Physik, 34. 4. pp. 285–295, 1925.)—The methods employed in investigating the hydrogen nuclei or protons ejected when α-particles collide with the atoms of hydrogen and various other elements include the scintillation method and a modified Wilson condensation method. Mühlestein in 1922 mentioned some experiments on the photographic action of the H-rays, but no definite results have been recorded. The authoress points out that, owing to the small number of H-particles produced even with relatively strong sources of α-radiation, the exposures have to be long, with the result that β and γ-rays from the source, the Colson-Russell effect, metal rays and photo-activity are liable to blur the photographic plate, and special precautions are therefore necessary. The experiments were carried out by a method similar to that employed by Michl for α-rays, the H-particles passing at a rather steep angle into the photographic film, and showing straight tracks of blackened dots when the film was developed. Using polonium α-rays passing through a thin layer of paraffin, with a thin copper foil to absorb all α-particles, tracks up to 44μ in length were found with as many as eleven points of blackening. Experiments using RaC as the source of the α-particles were unsuccessful, as it was not possible to get rid of the action of the β and γ-rays from the preparation. Control experiments were made using a layer of lamp-black instead of paraffin. This contains very little hydrogen, and very few H-particle tracks were found; these may have been due to the disintegration of carbon. Tracks were also obtained when α-rays from polonium were sent through aluminium.

H. N. A.

316. *Period of Decay of RaE.* **G. Fournier.** (Comptes Rendus, 181. pp. 502–504, Oct. 19, 1925.)—After describing the method of preparation of RaE from lead containing a mixture of RaD + E, the author gives the results of a series of measurements of its rate of decay. Three different sources give the values of the "half-value" period, 4·86 days, 4·84 days, and 4·85 days respectively. A. B. W.

317. *Variation of Mass of Electron with Velocity, using Homogeneous β-Rays.* **R. A. R. Tricker.** (Roy. Soc., Proc. 109. pp. 384–396, Oct. 1, 1925.)—An accurate method of determining the variation of mass of an electron with its velocity is described. The method consists in the acceleration of the "line" β-rays from RaB and RaC, in a focusing apparatus, and is found to give results of a similar order of accuracy to that obtained by Bucherer. The results, using rays of velocity up to 0·8 that of light, agree with the theory of relativity within the limits of experimental errors. A. B. W.

Gesell., Zurich, May, 1925.)—The specific heat of electrolytes are markedly lower than those of non-electrolytes, a solution of an ionogenic salt having a lower value than that of the contained water. This effect is attributed to the influence of electric forces which react between the ions and the molecules of water. A method is indicated whereby these forces can be evaluated quantitatively and a calculation made of the specific heat of electrolytes. A formula is applied for expressing the electrical work necessary to remove the electrical polarisation of the water bipoles around the ions. This is given by $e^2(D - 1)/2aD$, where e is the charge on an ion, a its radius, and D the dielectric constant of the solution. A determination is then made of the negative work of compression performed in releasing the water bipoles from the high pressures, amounting to an order of 10,000 atm. exerted by the field of the ions. The sum of these two items is the difference in free energy of the solvent and solution, while the total energy U of the electrolytic solution is given by $U = f - T\partial f/\partial T$, f being the free energy. The specific heat of the solution C_v is given by $(\partial U/\partial T)_v$. Data on the specific heat of water at high pressures can be derived from measurements on the specific volume at high pressures by the relation $\partial C_p/\partial T = - T\partial^2 v/\partial T^2$. Deductions on the hydration of ions may be drawn from deviations in particular instances, and the method enables the factors of coefficients of expansion, compressibility and volume contraction on solution to be treated quantitatively. J. N. P.

325. *The Ratio of the Specific Heats of Hydrogen.* **J. R. Partington** and **A. B. Howe.** (Roy. Soc., Proc. 109. pp. 286–291, Oct. 1, 1925.)—The method employed is described in Abstract 1221 (1924). The value found for the ratio of the specific heats γ is 1·4113 ± 0·0002. For comparison the following values for γ given by various authorities are quoted and discussed: Cazin (1·41), Dulong (1·407), Jamin and Richard (1·410), Masson (1·401), Roentgen (1·3852), Lummer and Pringsheim (1·4084), Shields (1·4012), Brinkworth (1·4070). The authors reply to the criticisms by Brinkworth [see Abstract 1686 (1925)] of their previous experiments. E. G.

326. *The Latent Heat of Vaporisation of Liquid Oxygen-Nitrogen Mixtures.* **L. I. Dana.** (Am. Acad., Proc. 60. pp. 241–267, Oct., 1925.)—Latent heats of vaporisation at atmospheric pressure of liquid oxygen and nitrogen, and of mixtures of the two in all proportions have been determined. The calorimetric method adopted is that of continuous flow. A small volume of the liquid is thermally isolated by means of a glass bulb, surrounded by a vacuum jacket, communicating with a large volume of the liquid through a capillary tube. Heat is supplied electrically through a heating coil in the bulb, the current and voltage being determined with a high precision potentiometer. The volume of the evaporated gas is measured by a laboratory gas meter of the wet type. The design of apparatus keeps down the leakage of heat to a very small fraction of the total heat supplied, the leakage being, however, measured and allowed for. The latent heat measured is carefully defined, involving the change in heat-content from the liquid to the vapour state vertically above it on the vapour line in the temperature-composition diagram. Some of the final values given for the latent heats of vaporisation at 1 atmosphere in calories (15° C.) per gramme are as follows: Liquid oxygen, 51·01; nitrogen, 47·74; 25 % O + 75 % N, 49·28; 50 % O + 50 % N, 50·48; 75 % O + 25 % N, 51·17; an accuracy of 0·1 % to 0·2 % being estimated. With the aid of data on latent heats and on specific heats of the superheated vapours it is shown that the latent heats of the mixtures can be calculated. T. B.

327. *The Law of Depression of Freezing-Points in Metallic Alloys.* **K. Honda** and **T. Ishigaki.** (Tôhoku Univ., Sci. Reports, 14. pp. 219–233, July, 1925. In English.)—Gives an account of the application of the law of Planck on the depression of freezing-points, not only to alloys of metals which form simple eutectics, but also to metals which form solid solutions and to allotropic changes which take place in the solid phase. Some previously published results are used, but a considerable number of new determinations have been made in connection with the work. It is concluded that the freezing-point of pure metals is proportional to the concentration of a second element, provided the solution is dilute. If the gram. molecular weight of a solute is dissolved in a given solvent, then the depression of the freezing-point, termed the atomic depression, is constant and independent of the nature of the solute, whether it forms a solid solution with the solvent or not. The lowering of the freezing-point obeys the law of depression as given by van't Hoff or Planck, that is, $\delta T = -\frac{RT^2C}{m\lambda}$ or $-\frac{RT^2(C_l - C_s)}{m\lambda}$. As in the case of usual solution, the law can be used for the determination of the molecular state of the solute present in the solvent. The same law is also applicable to the case of the transformations taking place in the solid phase. C. O. B.

328. *Photo-electric Radiation Pyrometer.* **F. A. Lindemann** and **T. C. Keeley.** (Phys. Soc., Proc. 38. pp. 69–73; Disc., 73, Dec., 1925.)—By means of two photo-electric cells with suitable coloured filters the energy radiated in two distinct spectral bands is compared. By combining the ascertained sensitivities of the two cells and their filters with the radiation law the black-body temperature of the radiator can be determined. AUTHORS.

329. *Vapour-Pressure and Miscibility of Binary Liquid Mixtures.* **K. F. Herzfeld** and **W. Heitler.** (Zeits. Elektrochem. 31. pp. 536–539; Disc., 539, Oct., 1925. Paper read before the Deut. Bunsen Gesell., Darmstadt, May, 1925.)—Van der Waal's theory for binary liquid mixtures leads to very complicated and not very trustworthy results. The present paper deals with experiments which are correlated on the basis of a theory due to Dolezalek. In this theory the form of the vapour-pressure curve of a mixture depends on the heat evolved when the constituents are mixed, and an equation for the curve can be deduced on thermodynamic grounds. Fair agreement between theory and experiment is shown for a mixture of CS_2 and $(CH_3)_2CO$. A. A. D.

330. *Vapour-Pressure of Sodium.* **W. H. Rodebush** and **T. de Vries.** (Am. Chem. Soc., J. 47. pp. 2488–2493, Oct., 1925.)—The calculation of the vapour-pressure of a metal from the boiling-point and the quantum theory of monatomic gases is likely to involve a considerable error and renders a direct measurement desirable. Knudsen's method for the determination of vapour-pressures was modified to suit the conditions. An apparatus was constructed of pyrex glass, in which the vapour-pressure of sodium was measured over a temperature range 181·8° to 597°. An equation was derived to express the vapour-pressures from 180° to the boiling-point, which, if the accepted value for the boiling-point is correct, can be used to calculate vapour-pressures over the whole range. The equation is empirical, namely, $\log p = -5922/T - 1\cdot6184 \log T + 12\cdot9605$. The entropy of sodium vapour at 298° K and 1 atmosphere is calculated to be $35\cdot7 \pm 0\cdot5$. F. J. B.

331. *Measurement of Vapour Tension of Gasoline and Other Liquids.* **H. S. Davis.** (Indust. and Engin. Chem. 17. pp. 1136–1138, Nov., 1925.) —The method consists of determining the pressure exerted by a mixture of air and saturated vapour, and then determining the additional pressure necessary to compress the mixture to half the volume. An apparatus has been designed to enable this to be done as a routine operation. The bomb method of the U.S. Bureau of Explosives is severely criticised. W. G. B.

332. *Comparison of the Theory of the Explosive Wave with some Recent Experiments.* **E. Jouguet.** (Comptes Rendus, 181. pp. 546–548, Oct. 26, 1925.)—Laffitte [Abstract 2184 (1924)] has recently observed waves of shock and combustion having the velocity of a plane explosive wave. This observation is contrary to the prediction of the present author, and the paper is an attempt to remove the contradiction. Velocities of propagation in different gases and mixtures of gases are calculated, using values of specific heats according to Kast instead of those of Mallard and le Chatelier. Agreement with observed values is satisfactory for hydrogen, but less so for CO. Explanations of discrepancies are given. W. V. M.

333. *A New Form of Radiometer.* **R. L. Hanson.** (Optical Soc. America, J. and Rev. Sci. Inst. 11. pp. 283–288, Sept., 1925.)—The drift of gold-leaf in an electroscope, due to convection currents caused by uneven heating, has been utilised to construct an instrument utilising this effect for measurement or detection of radiant energy. Details of a preliminary instrument are given, but finally a Rayleigh disc suspended by a quartz filament was used. The disc was of aluminium foil 3 × 4 cm. in dimensions. An absorbing target T, in the enclosure containing the disc, was made of silver blackened with lampblack. The target was 0·025 mm. thick. No radiation could strike the instrument except at the window. The disc deflections were recorded by reflection from a mirror attached to the disc by a coarse quartz fibre, and lamp and scale method were adopted. The scale was set up 2 metres away, and the range of the instrument used was such as to show a linear relation between watts energy flux and scale deflections. The instrument gives a sensitivity of approximately 8×10^{-9} watts/mm., and higher values could be obtained. It has, however, the disadvantage that the disc has a long period, and takes ten minutes or more to return to zero. A standard candle at a distance of 1 metre gives a deflection of 980 cm. on a scale 1 metre distant from the instrument. S. G. B.

334. *On the Derivation of Planck's Law from Einstein's Equation.* **A. S. Eddington.** (Phil. Mag. 50. pp. 803–808, Oct., 1925.)—It is generally considered that Einstein's investigation in [Abstract 654 (1917)] gives the clearest insight into the origin of Planck's law of radiation. The argument, however, assumes Wien's displacement law and Boltzmann's formula for the relative numbers of systems in different states of energy in an assemblage at given temperatures. It is now shown that the assumption of Boltzmann's formula is unnecessary, since this, together with Planck's law can be deduced directly from Einstein's equation. The latter is now given, from which the author claims the advantage by his modification of no assumptions being made other than those plainly stated. The better exposition of the force and comprehensiveness of Einstein's method is in consequence made apparent. H. H. Ho.

335. *The Difference between the Various Forms of the Main Expressions in Thermodynamics.* **W. Jazyna.** (Phys. Zeits. 26. pp. 622–628, Oct. 3, 1925.)—A theoretical paper discussing, for the case of two simple examples, the exact part played by the choice of the form of the fundamental thermodynamical expressions used in the solution of the problems of (*a*) the transformation of heat into work, (*b*) the determination of the state of the heated body. It is pointed out that in many cases the form of the equation used is immaterial, but this does not always occur. The term " quantity of heat " is first discussed, and then follows a detailed dissertation on the terminology to be employed in thermodynamics and the precise meanings to be applied to the various quantities. S. G. B.

336. *The Thermodynamic Properties of Calcite and Aragonite.* **H. L. J. Bäckström.** (Am. Chem. Soc., J. 47. pp. 2432–2442, Oct., 1925.)—The heats of solution of calcite and aragonite in hydrochloric acid have been obtained under two sets of conditions—in pure acid and in acid saturated with carbon dioxide. The difference between the heats of solution of the two forms gives 30 ± 20 cals. per mol. for the heat of transition from aragonite to calcite at 25° C. ; the corresponding difference in entropies at this temperature is 0·74 entropy unit per mol., a value which is estimated to be accurate to at least 0·2 entropy unit. The entropy difference obtained from available specific heat data and the third law of thermodynamics is 2·4 entropy units. The discrepancy between these values is ascribed to error in one of the specific heat curves, and it appears probable that the values for calcite at the lowest temperatures are high. A. W. L.

SOUND.

337. *Numerical Constants of Speech and Hearing.* **H. Fletcher.** (Bell System Techn. J. 4. pp. 375–386, July, 1925.)—A useful collection of quantitative data, including graphs, concerning absolute sensitivity of the ear, minimum audible power for a normal ear, range of audition in frequency and intensity, minimum perceptible increase in intensity and frequency, the number of vibrations necessary to determine pitch, masking effect of one sound upon the audibility of another sound, conduction of skull between the two ears, localisation of pure tones as a function of the phase-difference at the two ears, constants used in the computation of the loudness of a complex sound, dynamical constants of the hearing mechanism, speech energy, frequency of occurrence of English speech sounds and interpretation of speech. W. H. Ge.

338. *Sounds of Speech.* **I. B. Crandall.** (Bell System Techn. J. 4. pp. 586–626, Oct., 1925.)—An extended study of 160 graphical records, tracings of some of which are reproduced, dealing with vowel and consonant sounds. The recording apparatus is elaborate and consists of three important units: (1) A condenser transmitter of thoroughly investigated frequency characteristics in both amplitude and phase. (2) A seven-stage amplifier with resistance-capacity coupling. Six valves in cascade give a voltage amplification of about 40,000, and eight valves in parallel form a current transformer working into the low impedance of (3) the oscillograph vibrator. This was specially constructed with small mass, high tension and damping. The complete system has practically uniform amplitude characteristic from 500 to 5000 per sec., without serious departure from this level for frequencies from 50 to 500 per sec. The phase lag is nearly a linear function of frequency from 125 to 5000 per sec. after passing through a period of lead in the narrow interval from 50 to 215 per sec. The calibrations in amplitude and phase lag were tested by comparing the calculated and observed distortion when a square-topped acoustic wave was impressed on the condenser transmitter by a special apparatus.

It is impossible to summarise briefly the comments of each of the 160 records as the paper claims rather to present a set of faithful records, to be supplemented later, rather than to reach final conclusions upon the nature of speech sounds. Careful comparison with the results of Paget is made. At the present stage of the work it is possible to state that the progressive change in wave-form from cycle to cycle of the fundamental, particularly at the beginning of a sound, is an important factor in determining the character of speech sounds, and it becomes most important in the study of the more impulsive consonant sounds. The original paper should be consulted. W. H. Ge.

339. *Speech Power and Energy.* **C. F. Sacia.** (Bell System Techn. J. 4. pp. 627–641, Oct., 1925.)—Deals with the energy of speech waves from the point of view of the telephone engineer who has to provide against load distortion. The apparatus is similar to that used in the work of

I. B. Crandall [see preceding Abstract]. The oscillograph has two series-connected vibrators, one of which is sensitive to low frequencies only and records the mean power. The other vibrator, which records the instantaneous power, has uniform response up to frequencies of 6000 per sec. The "power" of speech waves is considered in four parts: (i) instantaneous, (ii) mean, (iii) long average and (iv) short average power. W. H. Gʀ.

340. *Effect of Liquids on the Frequency and Amplitude of Vibrating Strings.* **H. Martin.** (Ann. d. Physik, 77. 7. pp. 627–657, Oct., 1925.)—An oscillating circuit of variable frequency is employed in which the current from a valve is passed through coils wound round the limbs of a permanent horse-shoe magnet. The magnet sets the string in vibration, and the amplitude of the vibrations is measured by a microscope. Resonance curves are drawn from which the natural frequency of the string is found, and the decrement is determined from these curves by use of the same formula as for electrical circuits. Difficulties arise when string vibrations take place in air, as it is found that the frequency depends on the amplitude, also the string does not possess one fundamental tone, but two tones nearly equal, and loosely coupled. In different liquids the decrement is determined as a function of the frequency, radius and density of the string, and of the density and viscosity of the liquid. The lowering of the tone by the liquid is in accordance with the theoretical lowering as given by Kalähne [see Abstract 1083 (1915)]. G. E. A.

341. *Piezo-electric Crystal Oscillators Applied to the Precision Measurement of the Velocity of Sound in Air and CO_2 at High Frequencies.* **G. W. Pierce.** (Am. Acad., Proc. 60. pp. 271–302, Oct., 1925.)—Crystal oscillators of the type previously described [Abstract 646 (1924)] were employed in a very simple method for measuring the velocity of sound at high frequencies. The crystal oscillator is very sensitive to the sound waves reflected from (say) a metal screen, so that a microammeter suitably connected in the anode circuit of the valve generator shows a sharp maximum for each half-wave-length of displacement of the reflector. In this way the velocity of sound in air has been determined for a range of frequencies between 40,000 and 1,500,000 cycles per second, and in CO_2 between 40,000 and 205,000 cycles per second. In the case of CO_2 a progressive increase of velocity was found as the frequency was raised, and combined with this was a large absorption at the higher frequencies. At 1,034,060 cycles per second CO_2 was found to be practically opaque. Minor changes in velocity were found also in the case of air, but it is not certain whether these are real effects or due to experimental errors. The effect of humidity of the atmosphere on the velocity of sound was found to be negligible at high frequencies. A. W.

342. *Absolute Temperature Measurements in Stationary Sound Waves.* **J. Friese** and **E. Waetzmann.** (Zeits. f. Physik, 34. 2–3. pp. 131–141, 1925.)—A continuation of previous work [Abstract 174 (1925)]. Using similar apparatus (a linear resistance thermometer and a valve amplifier) absolute values are found for the temperature amplitudes at the nodes of stationary sound waves, and hence the sound intensities calculated. Simultaneously the pressure amplitudes are measured by a membrane manometer. The temperature amplitudes calculated from these are in satisfactory agreement with those given by the resistance thermometer for frequencies from 400 to 1000. G. A. S.

343. *The Measurement of Acoustic Impedance with the Aid of the Telephone Receiver.* **A. E. Kennelly.** (Frank. Inst., J. 200. pp. 467–488, Oct., 1925.)—In this paper a method is described of measuring the acoustic impedance of solids or gases, in the form of discs or cylinders, to the passage of plane waves of sound. The method is based upon the reaction of the acoustic conductor upon the vibrations of a telephone receiver diaphragm which is used as the source of plane waves in a tube. This reaction in the receiver has been measured electrically by connecting its coils in the fourth arm of a Rayleigh bridge. The method also depends upon certain analogies between uniform electric-line conductors carrying alternating currents, and acoustic-tube conductors carrying sound. Essential facts concerning these are summarised at the outset. A comparison then follows between electric and acoustic-line constants. Full experimental details are described for measurements of acoustic impedance with a telephone receiver and with quarter-wave and half-wave acoustic conducting tubes. The problem of the composite electric line is also treated. A very full bibliography completes the paper. H. H. Ho.

344. *"Behm" Echo Depth Sounder.* (Engineering, 120. pp. 595–596, Nov. 13, and pp. 629–631, Nov. 20, 1925.)—A complete description, with numerous diagrams and photographs, is given of the apparatus used in the Behm method of depth sounding. The apparatus comprises (*a*) the cartridge-firing apparatus, (*b*) the recording instrument, (*c*) a microphone used to start the recorder when the cartridge explodes beneath the surface, (*d*) a second microphone (shielded from the direct effect of the explosion by the hull of the ship) used to stop the recorder when the echo from the sea-bottom reaches this microphone, and (*e*) suitable electrical arrangements. The recorder is made in three types, differing in range and in the method of indicating the amount of rotation of the disc started by the microphone (*c*). The first records depths up to 100 fathoms, the second up to 400 fathoms, and the third to 4000 fathoms. For the greater depths larger detonating charges are required to operate the gear satisfactorily, but an aural method of reception of the echo is possible with smaller charges, and when combined with a device for determining the error due to the personal equation of the observer this aural method gives sufficient accuracy for all practical purposes. For details of construction and operation the original paper should be consulted. A. W.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

345. *Energy of a Straight Current.* **L. Page.** (Am. J. Sci. 10. pp. 398–407, Nov., 1925.)—Hering's statement that the energy per unit length of an infinitely long straight current is finite [see Abstract 690B (1925)] is found to be incorrect. The present theory is based on the fact that current in the form of a cylindrical shell is equivalent at external points to a filamentary current. Two coaxial cylinders joined at their ends by flat annular discs are supposed to form a circuit so that current passes up one cylinder and down the other; in the limit when the cylinders coincide there is no energy, but if the radius of one remain at a value P while the radius of the other decreases to R, the current having a steady value i, (1) work equal to $i^2 \log P/R$ is done by the mutual attractions of the elementary filaments into which the sheet of current may be divided; (2) work equal to double this amount is done against the back e.m.f. set up by the movement; (3) the difference, *viz.* $i^2 \log P/R$, is the energy per unit length stored in the magnetic field. This becomes infinite when the radius of the outer cylinder becomes infinite. The mechanical force acting on each of the end discs has a similar value, and an experimental verification of this deduction gave results of the right order. Calculation shows that the force in question is independent of the permeability of the material of which the discs are made. C. W. H.

346. *Magnetic Flux Energy.* **C. Hering.** (Frank. Inst., J. 200. pp. 747–756, Dec., 1925.)—To get basic fundamentals the system based on the single conductor (one far removed from its return) is claimed to be far better than the one by Maxwell based on the "complete circuit" which involves infinities. In a previous article [Abstract 690B (1925)] the basic constant $i^2/2$ ergs per cm. was deduced for the energy stored in a steady current i in such a conductor; the deduction is based on the internal stresses produced by currents. This differs from our previous beliefs that it was infinity. It is explained that this disagreement is due to the fact that in some of our former methods of calculating the magnetic flux energy, components had been added to their resultant which already contains them. This leads to a revision of such calculations and to the necessary recognition of what might be called wattless flux, referring to that flux whose energy had already been accounted for, or represented by, other flux in the same field. It also leads to clearer conceptions of the true meanings of a self-inductance. This error is greatest in very large circuits and less in those used in practice; hence, is of theoretical rather than of practical importance. Being proportional to the length l of the single straight conductor, this $li^2/2$ energy corresponds to the $mv^2/2$ energy stored in a moving body. A new and simpler proof of this constant is given, based only on Maxwell's laws for such conductors and on the work done by the internal mechanical stresses, while this stored energy is being set free. AUTHOR.

347. *Contact Electric Layers.* **M. Satô.** (Tôkoku Univ., Sci. Reports, 14. pp. 313–320, July, 1925. In English.)—In a previous paper [Abstract

726 (1923)] the author has reported that when certain melted dielectrics, such as wax or resin, are solidified on a metallic plate, and then separated from it, some surface charge appears on the contact surface of the dielectrics. The present investigation has been undertaken to make the nature of this charge clearer. First, the signs and relative values of the surface densities of the charge when resin or wax is brought into contact with several metals have been determined. Henning's measurements of the contact electric potentials are included. Next, experiments are described to test whether the surface charge is distributed only over the surface of the dielectrics or penetrates them to some extent; and also to decide whether the electric layers are caused by bringing the solid dielectrics and metals into contact. It is inferred that the apparent surface charge consists of double electric layers, one intense and near to the contact surface, the other weaker, farther away, opposite in sign and much thicker. The conclusion is drawn that the electric layers are caused only by the contact of dielectrics with metals or other dielectrics. Eleven diagrams and two tables of data are included. H. H. Ho.

348. *A New Case of Contact Electricity.* **E. Perucca.** (Accad. Sci. Torino, Atti, 60. 4 and 5. pp. 88–92, 1924–1925.)—An interesting method of electrification has recently been noted by U. Doi when introducing a hot metallic ball into an insulating liquid. If the temperature of the ball is high enough to produce a violent ebullition of the liquid, the metal and liquid assume a separating voltage, the potential of the ball surpassing 1000 volts in such a case. Doi attributes the phenomenon to the separation of the charge constituting the double layer at the liquid-metal surface during the violent boiling of the liquid. In the present paper the author endeavours to show that this result can be considered as another example of contact electricity. He, however, concludes that he has not been able to show definitely that this is the case, but that all the facts observed can be easily interpreted as contact-electricity phenomena. [See also Abstract 1465 (1920).] A. E. G.

349. *A New Case of Tribo-electricity.* **E. Perucca.** (Phys. Math. Soc. Japan, Proc. 7. pp. 112–113, June, 1925. In English.)—This is a somewhat elaborated account of work described in the preceding Abstract. The apparatus used is here more fully described by means of a diagram, and the following conclusions are drawn. A few indications of the fact that the metal oxides must be considered strongly electro-negative are found; it is observed that a newly nickeled surface acts in a sensibly different manner from the same surface some days old. But even in this case characteristic uncertainties and difficulties of seeking a voltaic or a tribo-electric series are met with. It is not found possible to arrange the metals in a series analogous to the voltaic one. There is not a decisive experiment showing the identity of electrification described by Doi and friction-electricity, but all the observed facts may be interpreted as tribo-electric phenomena (including Strömungsstrom). It is therefore considered that any other hypothesis about the origin of this electrification is superfluous. A. E. G.

350. *Piezo-electrically Forced Oscillations of Quartz-fibres.* **M. v. Laue.** (Zeits. f. Physik, 34. 5–7. pp. 347–361, 1925.)—Voigt's theory of piezo-electricity is applied to the oscillation of quartz fibres when subjected to an alternating electric field. It is suggested that the method can be

employed to deduce the piezo-electric constants of other crystals. The calculations are simplified by consideration of an infinitely thin fibre; a correction for thickness can be applied, due to Rayleigh. Also crystals only are considered which possess one threefold and three twofold axes.
A. C. M.

351. *Atmospheric Electric Observations taken at Yale University during the Total Eclipse of January 24, 1925.* **W. F. G. Swann.** (Frank. Inst., J. 200. pp. 489–496, Oct., 1925.)—Observations were made over a period of 30 hours, covering the time of eclipse, to measure the potential gradient and the residual ionisation in a closed vessel. A special form of water dropper was used in conjunction with a Dolezalek electrometer. The values of these two quantities are exhibited in curves and for comparison similar observations were obtained several days later. The fluctuations in potential gradient measured during the eclipse were not larger than the ordinary, encountered at all times so that very definite conclusions could not be drawn from them. The residual ionisation curve shows marked fluctuation during, just after, and more particularly just before totality. The sun, as a cause for these changes, is considered as acting through a corpuscular radiation, controlled by the earth's magnetic field and operating either directly or through the agency of hard X-rays or γ-rays produced when the corpuscles strike the higher regions of the atmosphere. R. S. R.

352. *Atmospheric Electric Observations taken at the University of Chicago during the Total Eclipse of January 24, 1925.* **E. N. Coade** and **W. W. Merrymon.** (Frank. Inst., J. 200. pp. 497–499, Oct., 1925.)—Observations of the potential gradient and the residual ionisation in a closed vessel were extended over a period of 3 hours coveiing the period of the eclipse. Two separate outfits consisting of a radio-active collector and Dolezalek electrometer were arranged, one in conjunction with a photographic recording drum and the other for eye-observations. The residual ionisation was observed by a scheme essentially similar to that of W. F. G. Swann (see preceding Abstract).

The two potential gradient curves agree qualitatively and suggest a rise during the eclipse to a maximum about 15 minutes after totality. The results for residual ionisation are such that no very definite conclusions can be drawn as to the effect of the eclipse upon the penetrating radiation. R. S. R.

353. *Effects of Atmospheric Electric Discharge upon the Potential Gradient.* **C. H. Dwight.** (Terrest. Magn. 30. pp. 101–110, Sept., 1925.)—A search was conducted to determine whether there were at all times present in the atmosphere small electrical discharges of the rapidity of lightning and perhaps continually taking place in the upper atmosphere. An apparatus was set up that would respond to rapid but not to slow fluctuations in the potential-gradient. By photographic means as well as by direct inspection it was possible to count the number of rapid fluctuations in a given time. The possibility of any effect due to the motion of charged clouds nearby was shown to be nil. It was found that, as far as the sensitivity of the apparatus permitted, there were no variations in the gradient that could not be attributed to lightning or other known causes. If there were any rapid changes in the atmospheric potential-gradient, they were less than about 18 volts per metre, except in the case of thunderstorms, when some interesting phenomena were observed. AUTHOR.

DISCHARGE AND OSCILLATIONS.

354. *Electric Discharges Defined.* **A. Dauvillier.** (Soc. Franç. Élect. Supplement to Bull. No. 50. pp. 1–4, Oct., 1925.)—As the result of the discussion in this paper the following are the definitions arrived at: *Brush.*—Anodic light in the form of a mobile tuft appearing, in gas at atmospheric pressure, at the surface of conductors for a field gradient sufficiently high. *Emanation.*—Voluminous brush filling the space between the electrodes. *Corona.*—Generic name given to anodic brushes and luminous kathodic granulations. *The Spark.*—Positive column of great density meeting the kathode, of short duration, hot, luminous, and usually noisy, degenerating into an arc in the case of a powerful and continuous source. *The Arc.*—Phenomena of the discharge in the gas characterised by a concentration of the positive column causing by its impact upon the kathode a hot point or kathodic spot with strong photo- and thermo-electric emission. A. E. G.

355. *Discharge of Electricity through Vacuum Tubes.* **R. Whiddington.** (Nature, 116. pp. 506–509, Oct. 3, 1925. Substance of three Tyndall Lectures delivered at the Roy. Inst., May–June, 1925.)—A general survey of the subject under the following heads: The region of the kathode, the anode region, and the central region of the tube. A photograph given shows that, so far as the luminous character of the discharge is concerned, flashes of uniform speed follow each other at equal intervals of time down the tube moving from anode to kathode. It is found that the emitted light, when examined with a spectroscope of high resolving power shows no signs of the Doppler effect. The suggestion made is that the visible light emitted is not due to moving positive ions but is a state of affairs produced by them. A. E. G.

356. *Further Researches on the Crookes' Tube.* **A. Dauvillier.** (Comptes Rendus, 181. pp. 601–603, Nov. 3, 1925.)—Gouy discovered in 1896 that if the sides of a Crookes' tube which has been used are heated a number of gas bubbles appear. Both Gouy and Campbell-Swinton were led to the conclusion that this gas is identical with that which disappears during the discharge, and that this effect is the cause of fatigue of fluorescence. An experiment is here described which it is claimed throws fresh light upon this question. It is also stated that the author has succeeded in making appear a positive afflux in a secondary dark space when working with neon in which the positive afflux is particularly brilliant. This afflux is too slow to generate a kathodic bundle, but it appears to be the general cause of dark spaces, in agreement with a previously described theory, according to which this region will be characterised by a local rarefaction of the gas. This question is briefly discussed. A. E. G.

357. *Electrodeless Ring Discharge.* **R. Wachsmuth and W. Schütz.** (Ann. d. Physik, 78. 1. pp. 57–71, Nov., 1925.)—Many years ago J. J. Thomson discovered that a glass bulb held in a coil of wire through which passes a high-frequency discharge current exhibits, as the pressure in the bulb is lowered, first a rose-coloured glow ring and then a dazzling white ring. Since then, among others, Wachsmuth and Winawer [see Abstract 136 (1914)] have offered explanations for this phenomenon. In the present experiments by arranging two small electrodes at right angles to the plane of the rings, *i.e.* in the direction of their axes, and by putting on a tension of about 50 volts the cross current generated by the tension is measured by means of a galvanometer. Through the fact that two maxima of conductivity are observed it would seem possible to explain the occurrence of the two rings by the ionisation condition of the gases. Against the correctness of this explanation it has been observed by other measuring methods that a current effect only occurs in the case of the white discharge. It is in an endeavour to settle this question that the present work was undertaken. A. E. G.

358. *The Formation of Active Hydrogen in the Creepage Corona Discharge.* **F. O. Anderegg** and **W. N. Herr.** (Am. Chem. Soc., J. 47, pp. 2429–2431, Oct., 1925.)—Investigation of the creepage corona discharge in hydrogen has shown that the yield of active hydrogen is increased by filling the discharge space with glass wool, although no appreciable yield can be obtained in tubes filled with fragments of earthenware or of flint. After a run of several hours the yield falls to a very small value, but the tubes slowly recover if left unused. These fatigue effects may be removed by discharging in nitrogen, or by admitting a trace of air into the tube and sweeping out with hydrogen; the yield is not affected by the intro. duction of traces of nitrogen or oxygen. A. W. L

359. *The Free Paths of Light Excitation and their Disturbances by Hydrogen Atoms.* **B. Dasannacharya.** (Ann. d. Physik, 77. 7. pp. 597–626, Oct., 1925.)—These experiments, which are carried out on the emission of light of moving atoms of hydrogen canal rays in an atmosphere of hydrogen lead to the following conclusions: The free path l_2 of the light excitation is independent of the velocity of the illuminated atoms; l_2 is measured for H_β and H_γ and found to be $2{\cdot}43 \times 10^4$ and $10{\cdot}8 \times 10^4$ cm. for a pressure of 1/1000 mm. Hg.; the free path λ_1 of the disturbance of the light emission is inversely proportional to the velocity of the illuminated atoms; λ_1 is measured for H_β and H_γ and is calculated for H_α. From the above it follows that for very low pressures ζ, *i.e.* the radiation of an atom per cm. of the path, is independent of the velocity of the atom. For higher pressures ζ diminishes with increasing velocity. On the other hand, σ, *i.e.* the radiation of an atom per second at very low pressures, is proportional to the velocity; but with rising pressure it diminishes with increasing velocity. The values of ζ and σ for H_β and H_γ are given for different velocities and pressures. It further follows that the curve of the intensity distribution of a Doppler band in the canal-ray spectrum cannot be similar to the particle number curve of the illuminated atoms in the canal ray. The quantity σ is directly proportional to the pressure in the observation space for constant velocity and low pressure; for high pressure it approaches a constant value, in agreement with the Wien formula. The Wien formula is also valid for the increase of intensity with pressure. The value of l_2 depends very considerably on the wave-length. It is four times as large for H_γ as for H_β. λ_1 is, on the other hand, nearly the same for H_β and H_γ; but for H_α it is four times as much as for H_β. Some conclusions may be drawn as to the influence of pressure on the dissociation of a molecule by noting in the distribution curve the number of illuminated atoms in the Doppler bands. The results are in accord with those obtained by dissociation in dilute solutions. A. E. G.

360. *Velocity Loss of Kathode Rays in Metal Foil.* **O. Klemperer.** (Zeits. f. Physik, 34. 5–7. pp. 532–544, 1925.)—The kathode rays used in this research were excited by means of a high-voltage battery. Homogeneous beams were obtained with electron velocities ranging between 4 and 13 kilovolts. After passage through metal foil such beams exhibit a continuous range of velocities. The breadth of this range increases with increased thickness of the metal foil and with the density of the material; it decreases very rapidly with increased primary velocity. The principal velocity v_m of the beam after passage through the foil is related to the primary velocity v_0 and the foil thickness x by the equation $v_0^4 - v_m^4 = ax$, where a is to a first approximation a constant. With increased primary velocity there is probably a small increase in the value of a. In the region of velocities dealt with ($4 \cdot 5 < v_0 < 6 \cdot 5 \times 10^9$ cm./sec.) the mean value of a found for aluminium was $6 \cdot 4 \times 10^{42}$, and for nickel 19×10^{42}. Photographic methods were employed in the work. [See Abstract 607 (1924).] A. W.

361. *The Attachment of Electrons to Gas Molecules.* **V. A. Bailey.** (Phil. Mag. 50. pp. 825–843, Oct., 1925.)—The apparatus used contains five parallel plates, maintained at the potentials required to produce a uniform field throughout; the three intermediate plates have identical openings at the centre of each, and the top plate is illuminated with ultra-violet light, so that it emits electrons which travel downward through these openings towards the bottom plate through the uniform field with a velocity W. It is assumed that in oxygen some of the electrons, on collision with a molecule, unite with it to form an ion, so that the stream which passes through the top opening consists of electrons and ions. After passing through, it diverges owing to the agitation of the electrons, and a certain fraction passes through the second opening, the remainder striking the plate; similarly, what passes through the second opening diverges and part passes through the third opening and so reaches the lowest plate, while the rest is caught on the plate in which is the third opening. These different quantities of electricity are measured, and conclusions are drawn as to the proportion of collisions in which ions are formed with air in the apparatus. In a note, **Townsend** calls attention to a recent investigation by Brose, which shows that the number of ions formed in oxygen is greatly reduced when the apparatus is constructed of materials on which oxygen has no chemical action, such as ebonite, and the surfaces are carefully cleaned. The use of ebonite as an insulator in the interior of the apparatus was made as small as possible by Bailey. H. N. A.

362. *Impact Experiments in Compound Gases: Ammonia.* **Alma T. Waldie.** (Frank. Inst., J. 200. pp. 507–518, Oct., 1925.)—Experiments are carried out on similar lines to those described in a previous paper [see Abstract 1540 (1924)], and a critical point for NH_3 is found at about 11 volts. It is apparent that ultra-violet light may safely be used for impact measurements in a dissociable gas, certain experimental precautions being observed. The ammonia point is determined by photo-electrically liberated electrons in fresh gas, the dissociation through ultra-violet light proceeding slowly. The critical point is also determined with thermions by so arranging that collisions take place at some distance from the filament, which is an active dissociating agent. A. B. C. L.

363. *Gas Currents in Electrolytes.* **A. Coehn.** (Zeits. Elektrochem. 31. pp. 552–554, Oct., 1925. Paper read before the Deut. Bunsen Gesell., Darmstadt, May, 1925.)—The question of gas carrying current in electrolytes is discussed. In electrolytes which contain few ions, their movement under a great fall of potential does not take place according to the law of Hittorff, at any rate so far as concentration changes in neutral electrolytes are concerned. It is probable that space discharge plays a considerable part. The movement that was observed in the neighbourhood of the electrode was caused, not by a primary movement of gas bubbles, but by the primary action of the ions, which, in the immediate vicinity of the point electrode, have a very great velocity and consequently carry both liquid and gas bubbles along with the stream. F. J. B.

364. *Ionisation and Resonance of Gas and Vapours.* **L. Brüninghaus.** (Rev. Gén. d'Él. 18. pp. 683–691, Oct. 24, and pp. 731–737, Oct. 31, 1925.)—These papers deal with the subject in a general way along the following lines :—In the first paper : The dynamics of electronic collisions at very low velocities ; the experimental study of potentials of ionisation and of resonance ; critical potentials and spectral rays ; normal and meta-stable atoms. The second paper deals with photo-electricity and the quantum theory, and statistical equilibrium between electrons, atoms and radiation. A. E. G.

365. *The Ageing Effect in the Mobility of Positive Ions.* **H. B. Wahlin.** (Nat. Acad. Sci., Proc. 11. pp. 606–608, Oct., 1925.)—This paper is a reply to an attack by Loeb [see Abstract 157 (1926)] on the present author's results on the ageing in the mobility of the positive ions [see Abstract 1716 (1925)]. The writer (H. B. Wahlin) found that if the mobility was measured soon after the ion was formed, and then again when the ions were aged, the value fell from 1·80 to 1·35 cm./sec./volt/cm. Loeb found that owing to the interaction of the alternating and the auxiliary fields a change in the mobility could be produced by a change in the auxiliary field alone. As this result can be explained without reference to any ageing effect, Loeb considers that the results obtained by Wahlin are approximate only. The present paper includes further evidence of the effect in question. For example, at a pressure of 30 mm. and with an auxiliary field of 1·5 volts the value 1·35 was obtained. If the ageing time was reduced by increasing the auxiliary field to 3 volts, the mobility increased to 1·80, and no further change was produced by further increase in the auxiliary field. At a pressure 10 mm. a field of 1·5 volts gave a value 1·80, and an increase of the auxiliary field to 3 volts produced no change. If Loeb's contentions are justified, a change should be observed here also. In the second experiment it is clear that the ions reached the gauze before ageing even with a field of 1·5 volts/cm. Further evidence is afforded by Erikson's experiments, without the use of a gauze, which gave the same ratio between the aged and unaged ions. [See Abstract 642 (1925).] T. B.

366. *Structure of the Hydrogen Molecule Ion.* **H. C. Urey.** (Nat. Acad. Sci., Proc. 11. pp. 618–621, Oct., 1925.)—The steady state of lowest energy of the hydrogen molecule ion should be that in which the electron vibrates in a straight line perpendicular to the line joining the nuclei and passing through the middle point of this line. Assuming that the law of inverse squares holds between the electron and the positive nuclei and that the steady state is fixed by the Wilson-Sommerfeld quantum relation, the author arrives at formulæ for the potentials which agree with most of the observations of Olson and Glockler [Abstract 2247 (1923)]. If H_2^+ ions be first produced above 13·27 volts, this point, which Olson and Glockler had not observed, could not be observed. The heat of dissociation and moment of inertia of the hydrogen ion molecule are also considered. There should be an ultra-violet spectrum belonging entirely to the hydrogen molecule ion (free from the hydrogen molecule) between about 850 and 741 Å. H. B.

367. *Selective Photo-Effect.* **B. Gudden** and **R. Pohl.** (Zeits. f. Physik, 34. 2–3. pp. 245–248, 1925.)—Instead of the usual vacuum-cell, the authors use the boundary between an alkali metal and a solid transparent insulator. Experimentally, the effect is the same whether the alkali-metal be anode or kathode, the orientation of the electric vector is without effect, and the effect remains the same when the insulator is specially cleaned and dried before deposition of the alkali-metal on it. The authors conclude that the phenomenon is not one of the proper surface of the reflecting metal but is rather due to an invisible layer of very finely divided (probably atomic) metal, displacements in which would account for the results. A. D.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

368. *Conduction of Liquid Dielectrics.* **A. Gyement.** (Phys. Zeits. 26. pp. 686–687; Disc., 687, Nov. 3, 1925. Paper read before the Deut. Physikertag., Danzig, Sept., 1925.)—To explain conduction in dielectrics the author assumes that the liquid contains spherical water particles which, when subjected to an electric field, are polarised and distorted into an ellipsoidal shape. Equilibrium results between the decreased electric energy in this shape and the increased effects of surface tension. From the relation existing between the field strength and the extension of the drops, a further relation will connect field strength and water concentration in the liquid dielectric and this theoretical curve shows good agreement with the experimental results of Friese. There is thus obtained a displacement current of ions or electrons in the liquid. R. S. R.

369. *The Dielectric Constants of Ethane, Ethylene, Acetylene and Butylene, and the Symmetry of Unsaturated Bonds.* **C. P. Smyth** and **C. T. Zahn.** (Am. Chem. Soc., J. 47. pp. 2501–2506, Oct., 1925.)—The dielectric constants were determined by the heterodyne null method previously described by Zahn [Abstract 608 (1925)], for a number of different temperatures; they are in accord with Debye's theory of dielectrics as applied to gases. A graphical treatment of the results indicates that in the case of the first three gases the term in Debye's formula which contains the electric moment is zero, while the molecules of α-butylene have a small electric moment. The conclusion is reached that the electronic structure of an unsaturated bond is symmetrical, but the field of force around it is stronger than that around a saturated bond, so that, if the unsaturated bond is unsymmetrically located in the molecule, the induced electronic shifts will give a moment to the molecule as a whole. H. N. A.

370. *Photo-electric Action of Complete Radiation from Solid Bodies.* **A. Becker.** (Ann. d. Physik, 78. 1. pp. 83–111, Nov., 1925.)—Deals with the photo-electric excitation of aluminium by the complete radiation from tungsten at temperatures of 2100–3200° Abs. The excited electron emission (n) is connected with the absolute temperature (θ) of the radiator by the relation $n = \text{const.} \times \theta^x \cdot e^{-C_2/(\lambda_0\theta)}$ where the index x is greater than 2 and probably lies between 3 and 4. The velocity distribution of the photo-electrons is the same as that of the thermal electrons. The most probable velocity of emission of electrons is proportional to the absolute temperature of the source of radiation. A theoretical treatment is given. W. H. Ge.

371. *Photo-electric Conductivity at Low Temperatures.* **B. Gudden** and **R. Pohl.** (Zeits. f. Physik, 34. 2–3. pp. 249–254, 1925.)—Photo-electric conductivity is increased in NaCl crystals coloured by X-rays, at 80° and 20° Abs. The maximum is displaced, in comparison with the room temperature, towards smaller wave-lengths and appears at 0° Abs. to lie at about 380 $m\mu$. The author discusses a possible relation to the ionisation-frequency of the sodium atom. A. D.

372. *Standard High-Frequency Inductive Resistance and its Measurement by a Thermal Method.* **R. M. Wilmotte.** (Roy. Soc., Proc. 109. pp. 508–522, Nov. 2, 1925.)—The standard described takes the form of a coil of glass tubing containing mercury. The current enters and leaves the coil by platinum wires fused into the glass. One end of the coil is closed by a stopcock, while the other terminates in an open capillary tube with two marks on it. The entire coil acts as its own thermometer. The method of measurement consists in determining the time taken by the mercury to move from one mark to the other while the coil is being heated or allowed to cool. Two such coils were constructed and used by the author, and the results obtained are compared with those found by using two forms of the resistance variation method of measurement. The author concludes that for the present thermal methods must remain the basis of all high-frequency resistance measurements, and the method described by him gives an accuracy well within 1 % with a rate of dissipation of energy of the order of 1 watt. A. H.

373. *A New Method for the Determination of Dielectric Constants of Well-conducting Electrolytic Solutions.* **H. Hellmann** and **H. Zahn.** (Phys. Zeits. 26. pp. 680–682, Nov. 3, 1925. Paper read before the Deut. Physikertag., Danzig, Sept., 1925.)—In measuring dielectric constants of well-conducting solutions by the usual method of Drude, that of a bridge, or by the resonance method, it is essential to employ very high frequencies so that the magnitude of the capacity component of the current is high compared with that of the resistance component. On this account reliable measurements hitherto made have been limited to solutions with a conductivity not greater than 10^{-4}. The method at present devised is briefly summarised and is based on an evaluation of capacity changes from the damping instead of from the position of resonance. Determinations are made of the damping factor R/2L, the power factor ω^2CR, and the dielectric constant. The method is not limited to the use of small condensers as in former arrangements. A separate oscillating circuit is employed and the amplitude of the current when in resonance is compared with that given when the measuring condenser is replaced by a resistance wire of known inductivity. Curves are given in which the resonance current is plotted against the conductivity over a range of 0·001 to 0·1 mhos. Minima in the curves are obtained at a conductivity of about 0·01. A formula is derived according to which $60\sigma = \epsilon/\lambda$ where ϵ is the conductivity at the minimum amplitude or maximum damping and λ the wave-length. More exact estimations of the dielectric constants are made from the magnitude of the oscillation current at the minimum values. Curves are also given of the relations obtained with potassium chloride in water and in acetone water mixtures. [See Abstract 2359 (1925)]. J. N. P.

374. *A New Filament Electrometer.* **W. Kolhörster.** (~~Elekt.~~ Phys, Zeits. 26. pp. 654–657, Oct. 13, 1925.)—For the measurement of radiation the author had constructed an electrometer for his new radiation apparatus [Abstract 2963 (1924)]. As this has a general use in electrostatics it is now described in detail. The principle employed is that as the balancing force against the electrostatic forces the bending elasticity of a fine quartz fibre is utilised. The fibre is in the form of a loop the ends of which are attached to a thin metal sheet several millimetres apart. This metal sheet is set in an insulator, and the loop stands vertically quite freely. The effect of charging is to deform the loop, and the amount of alteration is observed through a microscope eyepiece. Illustrations are given of such an instrument and instructions for its use. The sensitivity of the instrument is high, and it is noted that it is particularly adapted for measurements of atmospheric electricity. S. G. B.

ALTERNATING CURRENTS AND MAGNETISM.

375. *Alternating Current Distribution in Cylindrical Conductors.* **C. Snow.** (Bureau of Standards, Sci. Papers, No. 509. pp. 277–338, 1925.)—In working out such distinct problems as that of propagation along parallel wires where the dielectric extends to infinity, and along a cable system where a conductor extends to infinity, a number of formal similarities become evident; and it may be difficult to see just how general are those similarities if the initial formulation of the problem is not sufficiently general. The fundamental equations for the potentials ϕ and A are simplified by an approximation which is valid from the lowest to the highest (radio) frequencies. This approximation is due to the difference in order of magnitude of the electrical conductivity of conductors and dielectrics. The case of N conducting cylindrical groups surrounded by any number of dielectrics is discussed and solutions obtained for ϕ and A which are proportional to $e^{ipt-\gamma z}$ representing a simple possible type of propagation along the cylinders. These lead to general formulæ for the coefficients of leakage, capacity, resistance and inductance, all of which are functions of the frequency in the general case, as well as expressions for the attenuation and phase velocity. The mean energy relations are also expressed in terms of these coefficients. Application is made to the case of two circular cylinders of different conductivity, permeability and radius, surrounded by a homogeneous, slightly conductive dielectric. Asymptotic formulæ for the alternating current resistance R and inductance L of the line at high frequencies are obtained, which, together with the exact expressions for the coefficients of leakage

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19

and capacity, lead to high frequency expressions for the attenuation and phase velocity. These are all functions of the frequency, because the current distribution is not uniform in the conductors. G. W. DE T.

376. *Demonstration of the Skin Effect.* **H. Busch.** (Phys. Zeits. 26. pp. 661–663, Oct. 1, 1925.)—The author has previously described a method for investigating the skin effect in a conductor [Abstract 2600 (1925)]. The present paper describes the application of this method to iron rods of diameter 2 to 3 cm. A detailed description of the apparatus is given. Two mirror galvanometers were employed to measure the amplitude ratio and the phase difference between the outer and inner currents traversing the rods used. It was found that for such rods the skin effect at frequencies as low as 0·5 to 1 period per second is very noticeable. A. W.

377. *Skin Action in Cylinders with Complex Permeability.* **B. Wwedensky** and **B. Schillerow.** (Zeits. f. Physik, 34. 4. pp. 309–329, 1925.)—Formulæ for the calculation of the resistances and self-induction are given as well as for the actual permeability and energy absorption of straight magnetisable wires. By this means the phase lag between the magnetic field strength and the magnetic induction depending on the properties of the ferromagnetic materials is taken into consideration. The formulæ obtained are an amplification of the well-known skin action formulæ of Zenneck. A. E. G.

378. *Magnetic Hysteresis at High Frequencies.* **W. Kaufmann** and **E. Pokar.** (Phys. Zeits. 26. pp. 597–600, Oct. 3, 1925.)—A short note on this subject has been previously published [Abstract 992 (1924)]. The present paper records the main results and the method used. The general conclusion arrived at is that with a frequency up to 500 per second the hysteresis loop for iron is the same as for smaller field variations and static magnetisation. The deviation lies within experimental error. Particulars of the test pieces and the hysteresis loops corresponding to them are given. Full experimental details are included, and the paper concludes with a theoretical treatment of the subject. The methods of production and measurement of the high-frequency currents are described and the results embodied in a table. S. G. B.

379. *Magnetic Transformation Points in the System Ferric Oxide-Magnesia.* **H. Forestier** and **G. Chaudron.** (Comptes Rendus, 181. pp. 509–511, Oct. 19, 1925.)—On the lines of previous research on the magnetic transformation points of ferric oxide in solid solution in alumina and in chromium sesquioxide [see Abstract 450 (1925)], mixtures of ferric oxide and magnesia prepared by simultaneous precipitation of their chlorides in known proportions are studied with respect to their dilatation and magnetic properties after heating for several hours to 400° C. With mixtures containing 2 % to 50 % Fe_2O_3, the transformation point is steady at 310° C., rising to 400° C. up to 56 % Fe_2O_3, from which point it is again steady up to the neighbourhood of pure Fe_2O_3. Over this last stage, a further transformation point, due to excess of Fe_2O_3, is observable at 675° C. The phenomena are considered to point to the existence of a ferrite of magnesia Fe_2O_3MgO. Similar indications are found of the existence of ferrites of Ni, Cr, and Cd. The transformation point in the Ni series is 590° C. The ferrites of Ca and Cd are rendered irreversibly non-magnetic on heating to above 700° C. and 400° C. respectively. A. B. C. L.

380. *Diamagnetism and Anomalous Zeeman-Effect.* **P. Tartakowsky.** (Zeits. f. Physik, 34. 2–3. pp. 216–226, 1925.)—On the assumption that also in diamagnetism the precession-frequency of the anomalous Zeeman-effect comes into play, a formula is developed for the magnetic susceptibility. This assumption seems to be justified. A. D.

381. *Intensity Variometer Corrected for Temperature.* **G. Hartnell.** (Terrest. Magn. 30. pp. 117–124, Sept., 1925.)—A compensating magnet is used to counteract the effect of temperature changes on the recording magnet. As the temperature rises the moment of the recording magnet weakens and this leads to an apparent decrease in the horizontal intensity. The field of the compensating magnet also weakens with rise of temperature. The actual field in which the recording magnet moves is the horizontal intensity diminished by the field of the compensating magnet. When the distance of the compensating magnet is properly adjusted the field intensity at the recording magnet increases in the same proportion as the magnetic moment of the recording magnet decreases. Experiments with an instrument constructed on these lines are described, and excellent compensation was obtained. A. A. D.

382. *Magnetic Measurements in the South of France.* **L. Maurel** and **R. Bélus.** (Annales des Postes, Télé. 14. pp. 805–822, Sept., 1925.) —The measurements were carried out in August and September, 1924. They relate to 22 stations in the departments of Aude, Ariège and Eastern Pyrenees. In each place the declination, dip and horizontal intensity were measured. The present paper does not contain the summarised observations, which are to be published elsewhere. It gives, however, the secular variation for the region over the epoch 1896–1922. These are ΔD (declination) $-$ 2° 52′; ΔI (dip) $-$ 0° 32′ and ΔH $+$ 0·0015. A. A. D.

383. *Terrestrial Magnetic Observations of the Gjöa Expedition,* 1903–1906. **A. Graarud** and **N. Russeltvedt.** (Geofysiske. Publ. 3. 8. [14 pp.] 1925.)—A preliminary account of the magnetic observations made during Amundsen's Gjöa expedition. The principal object of the expedition was to investigate the magnetic relationships near the magnetic north pole and to determine the position of this pole. A table showing the mean temperatures at Gjöahaven, the base of the expedition, is given. Values of D, I, H and Z are given for Gjöahaven and King Point, another station occupied for some time. Values are given as monthly averages from November, 1903, to May, 1905. Annual mean values are also included. Observations at several stations lead to the conclusion that the north magnetic pole is situated for the year 1904 at a point $\phi = 70° 30'$ N. and $\lambda = 95° 30'$ W. The position as found by Ross in 1831 was $\phi = 70° 5'$ N. and $\lambda = 96° 45'$ W. Tables show that D and H have a periodic variation indicating movement of the pole. Thus it is shown that the position of the north magnetic pole has a daily variation, the pole moving about a mean position in an elliptic orbit having a length of 23 km. and breadth 13 km. The deviation is greater at night than in the day. An annual motion is also detected, the pole moving at the

time of the observations directly eastwards with a mean velocity of $\frac{3}{4}$ km. per month. The motion is more complex than here described, but the main features are represented by a spiral motion eastward. Both daily and annual motion are in the direction of the motion of the sun. W. V. M.

384. *The Times of "Sudden Commencements" (S.C.s) of Magnetic Storms: Observation and Theory.* **C. Chree.** (Phys. Soc., Proc. 38. pp. 35–46; Disc., 46, Dec., 1925.)—An earlier paper [Abstract 1905 (1914)] discussed a number of data for the times of occurrence of the "Sudden Commencements" (S.C.s) of magnetic storms which had been published by L. A. Bauer in "Terrestrial Magnetism," and came to a conclusion adverse to Bauer's claim that S.C.s were propagated from east to west or west to east, with velocities of from 100 to 200 km. per second. Since that date papers on the subject have been published by S. Chapman and F. Rodés, of the Ebro Observatory, propounding theories differing from one another and from Bauer's. In a recent paper Bauer and W. J. Peters have re-discussed the subject. They conclude that the motion in longitude is much more rapid than according to Bauer's original estimate, and suggest that it is really a case of propagation from the magnetic equator towards either magnetic pole.

The Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics has recently approved a scheme aiming at the construction and use of special instruments to find out whether S.C.s have a finite rate of propagation. The present paper discusses the whole subject, partly with a view to facilitating a decision as to the new apparatus and the stations most suitable for the investigation. AUTHOR.

385. *Report on Magnetic and Electric Observations by the Carnegie Institution of Washington in Connection with the Total Solar Eclipse of January 24, 1925.* **J. P. Ault, S. J. Mauchly** and **R. H. Goddard.** (Terrest. Magn. 30. pp. 125–146, Sept., 1925.)—A temporary magnetic and electric observatory was established at Greenport, Long Island, by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington in order to determine any possible variations in the earth's magnetic and electric fields due to a total eclipse of the sun. Photographic registrations of changes in magnetic declination, horizontal and vertical intensities and in the electric potential-gradient of the atmosphere were obtained during the period January 12 to February 5, 1925. In addition, during the period 12h. to 17h. G.M.T. on January 22nd to 28th eye-readings of the variations in the electric potential-gradient, positive and negative conductivity and positive and negative ionic-content were made. In general, the eclipse magnetic effects, as far as can be determined from a preliminary discussion, agree with those observed during previous eclipses. Unfortunately, January 24th was somewhat disturbed magnetically. The eclipse electric effects were of the same nature as found during previous eclipses, but were smaller and showed some irregularities. AUTHORS.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

386. *The Application of Automatic Synchronisation of X-Ray Exposures to the Study of Intra-Thoracic Movements.* **F. M. McPhedran** and **C. N. Weyl.** (Am. Phil. Soc., Proc. 64. pp. 89–94, 1925.)—Unlike respiration,

cardiac control during radiography is not possible. The resulting radiograph may represent any chance phase of the cardiac cycle. The secondary action of the heart upon the surrounding lung tissues also causes loss of detail of the finer lung structures. The authors have experimented with various methods in order to secure radiographic exposure at the same desired phase of the cardiac cycle. A device for this purpose must be sensitive, stable, precise and easily operated. One method tried was to operate the X-ray apparatus by acoustic means, using a microphone placed over the patient's heart. The current in the microphone was amplified by thermionic valve apparatus. This apparatus was very sensitive, but very unstable as regards external sounds, friction, etc. A second method was to operate the X-ray generator by the amplified electromotive forces developed in the heart muscle and registered by the electro-cardiograph. This required too elaborate preparation of the patient. The method finally selected utilised a tambour sealed to a funnel-shaped applicator placed over the patient's carotid artery. This tambour carried a fine strut displacing a light mirror which, in turn, caused a beam of light to be thrown upon a sensitive photo-electric cell, the current from which was amplified by a thermionic valve apparatus, and the amplified current operated a time switch. To secure any desired period of the cardiac cycle this timing device could be given any desired lag with respect to the carotid pulse. Details of apparatus are not given, which, it is claimed, gave the desired degree of stability and preciseness.
B. J. L.

387. *Recent Progress in the Manufacture of X-Ray Tubes.* **Pilon.** (Soc. Franç. Élect., Bull. 5. pp. 445–457, May, 1925.)—Deals chiefly with the construction of Coolidge tubes and their variation for particular purposes as diagnostic and therapeutic radiology. Practically all the information given has been already described in detail in American and English journals. The Lilienfeld and Phillips metal tube are also briefly mentioned.
B. J. L.

388. *A New Rotating Ball Rectifying Disc.* **J. Servais.** (Arch. d'Él. Médicale, 33. pp. 112–144, Oct., 1925.)—Describes a rectifying disc arrangement of new design for transformer X-ray apparatus based upon "anti-corona" principles, and manufactured by Ropiquet, Hazart and Roycourt. Whilst the design is novel, no new physical principles are involved.
B. J. L.

389. *Some Particulars of Galvanic Current in an Electro-diagnostic Circuit.* **M. de Laroquette.** (Arch. d'Él. Médicale, 33. pp. 86–87; Disc., 88, Aug.–Sept., 1925. Paper read before the Assoc. Franç. pour l'avancement des Sciences, Grenoble, July, 1925.)—In electro-physiological circuits the direction of current flow, or polarity, is of the utmost importance with a galvanic (direct-current) circuit. The current varies with the current direction, period of application, relative electrode dimensions, and other factors, and often appears to pass more easily in one direction than the other. It also varies from period to period, and always gives a temporary increase of value on reversal, irrespective of direction of current flow. The author suggests that these variations are purely chemico-physiological, due to polarisation phenomenon in the damp electrodes and physiological tissues and also to a point and plate valve-like action, dependent upon relative electrode size. The subject of neuro-muscular excitability requires further study. In the *Discussion*, **M. Zimmern** suggested that some effects could be explained upon the basis of variation of physical quantities on reversal and " cataphoresis " or mass transport. B. J. L.

390. *High-Voltage Kathode Rays Outside the Generating Tube.* **W. D. Coolidge.** (Science, 62. pp. 441–442, Nov. 13, 1925.)—Describes effects produced by Lenard rays generated at 250 kv. with modern high-tension apparatus. These Lenard or kathode rays have a range of 46 cm. in the air. They give rise to intense luminosity in air and bend round until they extend more than half their range backwards to the tube. Calcite crystals fluoresce strongly and at the point of impact show microscopic crater formation. Chemical reactions occur in gases; for example, acetylene gas gives rise to a yellow deposit. Liquids, such as castor-oil and cane-sugar solutions, also undergo chemical change. The rays have very definite effects upon organised tissues; for example, rubber plants when rayed produce a white latex. Upon the ear of a rabbit various effects from epilation to necrosis were produced. Flies were killed by radiation and the rays are definitely lethal to bacteria. B. J. L.

391. *Review of Literature on Ultra-Violet Therapy.* **A. W. Hull.** (Gen. El. Rev. 28. pp. 790–797, Nov., 1925.)—The sun, carbon, iron, mercury vapour and tungsten arcs are compared as sources of ultra-violet light in favour of the mercury vapour lamp for clinical purposes.

Spectral distribution curves are given. Variations of radiation from the mercury vapour lamp are considered, and the increase of absorbtion of the quartz vessel with age and darkening are mentioned. Methods of intensity measurement are given and the application of the photo-electric cell advocated. The bactericidal actions of varying spectral regions are described, together with relationship of bactericidal and antirachetic powers. The stimulative action in rickets is considered as due to stimulation of the parathyroids controlling calcium and phosphorus metabolism. Dangers of ultra-violet radiation, as shown by animal experiments, appear to be confined to a temporary photophthalmia with a latent period of appearance and ultimate complete recovery, without effect upon structures deeper than the cornea and conjunctiva, unless heat rays are present to affect deeper structures. The clinical results upon various skin diseases are given. The action in rickets is presumed to be a variation in blood, accompanied by an increase of albumen, to which the parathyroids are sensitive. Other actions of ultra-violet lights are considered. The anti-rachetic vitamine is produced by radiating inert foodstuffs including cholesterol. As this compound is normally located chiefly in the skin, this may be the activated body in ricket therapy. The subjects of pigmentation and protective reaction are considered. B. J. L.

392. *Therapeutic Applications of Violet and Ultra-Violet Radiations.* **Jean Saidman.** (Soc. Franç. Élect. Supplement to Bull. No. 50. pp. 5–25, Oct., 1925.)—A review of the present applications of ultra-violet radiation for therapy, but containing very little new information. The following aspects are considered: historical, therapeutic results, historical and modern apparatus for the production of ultra-violet radiation, accessory apparatus such as localisers and intensimeters. B. J. L.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

393. *Adsorption of Gases by Graphitic Carbon.* **H. H. Lowry** and **S. O. Morgan.** (J. Phys. Chem. 29. pp. 1105–1115, Sept., 1925.)—The adsorptive capacity of various specially prepared graphites is measured in an apparatus which is arranged to include no stopcocks in the adsorption system, an enhanced accuracy being thus obtained. The graphites are prepared from Ceylon graphite by conversion to "graphitic acid," which is then exploded *in vacuo* to "pyrographitic acid," the latter being finally submitted to various degrees of oxidation and compressed into discs closely resembling the original graphite. Adsorption data for three samples of different adsorptive capacity are given for CO_2 and N (at several temperatures from 0° to 100° C.) and H at − 191° C. and at pressures up to 1 atmos. The results show that while graphite from the least oxidised "graphitic acid" (C : O = 3·98 : 1) adsorbs the least gas and that from the most oxidised "graphitic" acid (C : O = 3·12 : 1) adsorbs the most, there is no quantitative proportionality between the degree of oxidation and the amount of gas adsorbed. The highest adsorptive capacity observed with respect to N at 0° C. and 760 mm. pressure is nearly one-third of that shown by the best adsorptive charcoal. Support is found for the hypothesis that any treatment which will increase the ratio of surface to mass, or the degree of unsaturation of the atomic forces of a solid adsorbent, or both, will increase its adsorptive capacity. A. B. C. L.

394. *Layer Filtration and Theory of Gas Masks.* **W. Mecklenburg.** (Zeits. Elektrochem. 31. pp. 488–495, Sept., 1925. Paper read before the Deut. Bunsen Gesell., Darmstadt, May, 1925.)—The mathematical theory of the gas mask is developed, and a determination made of the dependence upon several factors of the "resistance time"—that is, the time which elapses from the beginning of the experiment until the first trace of poisonous gas is found in the air which has passed the absorbent. F. J. B.

395. *The Isotopic Composition of the Element Chlorine in the Meteorites: The Atomic Weight of Meteoric and Terrestrial Chlorine.* **W. D. Harkins** and **S. B. Stone.** (Nat. Acad. Sci., Proc. 11. pp. 643–645, Oct., 1925.)—The atomic weight of chlorine obtained from a meteorite was found to be the same as that of terrestrial chlorine within 0·003 %. The isotopic composition would thus seem to be independent of the source or history of the sample. The result also agrees with the previous work of Harkins, who has given reasons for expecting the lighter isotope to be the more stable. W. G. B.

396. *Influence of Metallic Elements on the Corrosion of Iron and Steel.* **Y. Utida** and **M. Saitô.** (Tôhoku Univ., Sci. Reports, 14. pp. 295–312, July, 1925. In English. 105th Report of the Research Inst. of Iron, Steel and other Metals.)—The resistivity to and corrosion of each specimen of iron and steel containing special elements is studied. The corrodibility is not the same for the three acids tested. Specimens containing chromium show a minimum corrosion in 10 % nitric acid, but corrode readily in the same strength of hydrochloric acid. Nickel and silicon give a high resistivity to the corrosion of iron against acids. Iron containing both nickel and chromium resists corrosion better than iron containing only one of the metals. As regards the combined effect of nickel, chromium and carbon in hydrochloric acid, better results are obtained by increasing the carbon in the range 0·1–0·7 %, and in sulphuric acid the best results are obtained with a carbon content of 0·3 %. Alloys containing high chromium and nickel and low carbon have a high resistivity to pure and mixed acids, but the corrodibility is considerably greater in mixed than in simple acids. F. J. B.

397. *Action of Sodium Chloride Solutions on the Ferrous Metals.* **R. Girard.** (Comptes Rendus, 181. pp. 552–555, Oct. 26, 1925.)—Cast-iron and steel plates, 50 × 50 × 3 mm., were immersed 50 mm. below the surface of either aerated or non-aerated 2 % sodium chloride solutions, and, at the end of each period of 12 or 24 hours, were removed from the liquid, washed, dried, rubbed similarly with the hand, weighed and then replaced. This treatment was continued for 272 days. In the non-aerated solution, both steel and cast iron lose regularly in weight, the metals being attacked uniformly. In the aerated solution, the action on steel also corresponds with a regular loss in weight, but the metal becomes deeply hollowed at the centre by corrosion figures. With cast iron the action is more complex, the first period of about a month showing a loss in weight, which later passes through a minimum, increases, after about four months assumes its initial value, and at the end of about six months reaches a constant value. These changes are due to the coating of the iron with a protecting layer. T. H. P.

398. *A General Theory of Solvent Systems.* **A. F. O. Germann.** (Am. Chem. Soc., J. 47. pp. 2461–2468, Oct., 1925.)—An investigation is made of the properties of ionising solvents which are not hydrogen compounds. A parent solvent is defined as an ionising solvent and the parent substance of a system of so-called solvo acids, solvo bases, and solvo salts. The solubility of polar substances in an ionising solvent is probably related to its dielectric constant and to its degree of ionisation. A solvo acid is an addition compound formed between the parent solvent $A_\beta B_\alpha$ and one of its slightly polar derivatives $N_\beta B_\nu$; the solvo acid is usually separable from the solution as a crystalline solvate, *i.e.* with one or more molecules of solvent of crystallisation. Typical compounds which illustrate this principle are the acids H_2SO_4, $HCuCl_2$, H_2SIF_6, and $H_2Pt(CN)_4$.

A parallelism is then drawn between this system of hydrogen acids and the phosgene system of acids, bases, and salts. A typical electrolyte in this case is $2AlCl_3 . COCl_2$ or $COAl_2Cl_8$ (phosgeno aluminic acid) which in phosgene solution is a good conductor dissociating into CO^{++} and $Al_2Cl_8^{--}$. On electrolysis of the solution CO is liberated at the kathode and Cl_2 at the anode. The solution dissolves metals with concomitant evolution of CO and the formation of salts of the formula MAl_2Cl_8 which crystallise with phosgene of crystallisation. The results are closely parallel with the behaviour of SO_3 in aqueous solution. The application of the theory to a number of other solvents is discussed. J. N. P.

399. *The Oriented Wedge Theory of Emulsions.* **W. D. Harkins** and **N. Beeman.** (Nat. Acad. Sci., Proc. 11. pp. 631–637, Oct., 1925.)—A discussion is given of the theory of Langmuir according to which the liquid which forms the inner phase and the size of the emulsoid particles is determined by the difference in sizes of the two ends of the molecules of the emulsifying agent, the molecules being oriented in the interface between the liquid phases so that the polar ends turn towards the polar liquid and the non-polar ends towards the non-polar liquid. Measurements are made of the distribution of sizes of particles with emulsions of a viscous oil, "stanolax," and with a very fluid oil, octane, when emulsified by sodium, potassium, and cæsium soaps. The distribution curves are found to be the same, within the limits of error, for each of these emulsifying agents in spite of the varying diameters of the metal atoms. With magnesium and aluminium oleates the water in oil emulsions which are obtained give distribution curves which are practically the same as those found for the oil in water emulsions. The method of mixing has an effect upon the distribution, the number of large drops decreasing with the time of stirring. It is concluded that the results give no proof for or against the oriented wedge theory, but indicate that some of the evidence formerly derived is not valid. In view of the ionisation of the alkali salts and of the very large size of the emulsoid particles compared with the molecules of the emulsifying agent, it is considered improbable that the molecules alone determine the size of the drops. J. N. P.

400. *Behaviour of Crystals and Lenses of Fats on the Surface of Water. Parts* 1, 2 *and* 3. *Part I.—Mechanism and Rate of Spreading. Part II.—Effect of Temperature on the Equilibrium Pressure. Part III.—Effect of the Polar Group on the Equilibrium Pressure.* **A. Cary** and **E. K. Rideal.** (Roy. Soc., Proc. 109. pp. 301–317, 318–330, 331–338, Oct. 1, 1925.)—*Part I.*—By means of a specially adapted chainematic balance, measurements are made of the variation with time of the surface tension of water and of N/100 HCl caused by the introduction of organic compounds containing a long chain terminating in a polar group, including acids, esters, ethers, phenols, and nitriles. It is found that unimolecular films spread from crystals as well as lenses, a definite equilibrium surface tension characteristic of the substance in question being established. A limit is established to the extension of expanded films and a theory postulating inelastic collisions of the surface molecules is advanced. Spreading oil films appear to be pushed out from lens or crystal by the further entry of molecules into the surface layer rather than pulled over the surface by the attraction of the uncontaminated water.

Part II.—Experiments are carried out to determine the effect of increased temperature on the phenomena already observed. With some compounds the water-oil interfacial tension is shown to rise rapidly with increasing temperature. It is suggested in explanation that such an interface can exist in either of two modifications corresponding to the condensed and expanded states of unimolecular films. The phenomena are discussed with reference to the phase rule and by an application of the Clapeyron equation the latent heat of fusion is calculated for some of the compounds studied.

Part III.—The study of the effect of temperature on the equilibrium surface tension resulting from the spread of a film from a crystal or lens on a surface of N/100 HCl is continued for a number of long-chain compounds with more complex polar heads. The effect of impurities, and of inoculating the surface with two different compounds is considered. A. B. C. L.

401. *New X-Ray Studies of the Ultimate Structures of Commercial Metals.* **G. L. Clark, E. W. Brugmann** and **S. D. Heath.** (Indust. and Engin. Chem. 17. pp. 1142–1146, Nov., 1925.)—For investigation of the effects of heat treatment and working on the structure of metals the monochromatic, pinhole, X-ray method is recommended. Reproductions of a number of X-ray photographs are given, which show different appearances for different treatments of the specimens. The method is a simple one, since only a source of monochromatic X-rays with proper protection, double pinholes and a photographic plate or film are required, and no polishing of the specimen is needed. In most cases the beam is passed perpendicularly through the specimen, but in others it is reflected at a suitable angle. The paper is regarded as distinctly preliminary.

H. N. A.

402. *Determination of Metals Dissolved in Mercury; Rapid Method of Purifying Mercury.* **A. S. Russell** and **D. C. Evans.** (Chem. Soc., J. 127. pp. 2221–2230, Oct., 1925.)—The order in which metals dissolved in mercury are removed therefrom by oxidising solutions is not the order of the electrode potentials of these metals in the free state, but, for the metals examined, is as follows: zinc, manganese, cadmium, thallium, tin, lead, copper, chromium and iron, bismuth, cobalt, mercury, nickel. This order seems quite definite and holds for different oxidising solutions, for hot and cold solutions containing either hydrochloric or sulphuric acid, and when other metals also are present in the amalgam. These results, which are interpreted in terms of the hydrogen over-voltages of the metals, furnish rapid, approximate methods of determining (*a*) the solubilities of metals in mercury, (*b*) tin and lead in solder, and (*c*) metals deposited by electrolysis with a rotating anode and a mercury kathode. It gives also a rapid method of purifying mercury from more electro-positive metals by shaking the amalgam with an oxidising agent, without loss of mercury.

T. H. P.

403. *Cementation of Metals by Volatile Salts.* **T. Peczalski.** (Comptes Rendus, 181. pp. 463–465, Oct. 12, 1925.)—The author has obtained the cementation of metals by heating in the presence of metallic salts, and finds this to be most rapid when the salts are volatile at the temperature of the experiment. The experiments were conducted with chromium chloride ($CrCl_3$) and nickel chloride ($NiCl_2$) heated in contact with copper contained in an iron tube, the method being that recently described [see Abstract 440 (1925)]. Photographs are included of cross-sections of the copper bars employed.

H. H. Ho.

404. *Ionic Equilibria across Semi-Permeable Membranes.* **M. Kameyama.** (Phil. Mag. 50. pp. 849–864, Oct., 1925.)—The experiments of Donnan and Allmand on the unequal distribution of potassium chloride across a copper ferrocyanide membrane between a pure aqueous solution and one containing potassium ferrocyanide are recalculated and discussed from the point of view of activity and the ionic strength principle of G. N. Lewis, according to which the mean activity coefficient of a salt in a solution of mixed salts should, for solutions which are sufficiently dilute, depend only on the "ionic strength" of the solution. If m_1 represents the ionic molarity of the potassium chloride and ferrocyanide and m_2 that of the potassium chloride solution, and f_1 and f_2 the respective activity coefficients, the ionic strength principle involves the relation $f_1 = f_2 m_2/m_1$, which should be equal to f_0, the activity coefficient of potassium chloride in a pure aqueous solution of this salt of equal ionic strength.

It is shown that, except when the potassium chloride concentration is small in comparison with that of the ferrocyanide, the results of the measurements of Donnan and Allmand are in agreement with this principle. The results are confirmed by further more elaborate determinations of equilibrium distribution concentrations which are made in the present work. J. N. P.

405. *High-Temperature Equilibrium in the Fe-C-Si System.* **M. L. Becker.** (Iron and Steel Inst., J. 112. pp. 239–252 ; Corresp. 253, 1925.)—The effect of silicon on the iron-carbon equilibrium has been studied by a series of cementation experiments. As the silicon increases up to 4 %, the solubility of carbon decreases. Below 940° C. the solubility drops rapidly to zero. J. L. H.

406. *Methods of Studying the Chemical Effects of Electric Sparks on Gases at Low Pressures.* **P. Jolibois.** (Comptes Rendus, 181. pp. 608–610, Nov. 3, 1925.)—A description is given of an apparatus specially designed to detect and measure changes in volume of a gas when subjected to electrical discharges at low pressures. A. B. C. L.

407. *The Critical Increment of Chemical Reactions.* **W. E. Garner.** (Phil. Mag. 50. pp. 1031–1033, Nov., 1925.)—The author replies to Hinshelwood's criticism [see Abstract 2392 (1925)] of the mode of derivation of an expression for the probability of a collision between active molecules yielding the reactive products, as given in a previous paper [see Abstract 1517 (1925)]. It is shown that this probability varies with temperature. J. S. G. T.

408. *The Properties of Activated Hydrogen.* **K. F. Bonhoeffer.** (Zeits. Elektrochem. 31. pp. 521–522 ; Disc., 522, Oct., 1925. Paper read before the Deut. Bunsen. Gesell., Darmstadt, May, 1925.)—Active hydrogen was discovered by R. W. Wood. The present paper is similar to that referred to in Abstract 709 (1925). It is preliminary in character, and a detailed publication is in preparation. F. J. B.

409. *Effect of X-Rays on the Platinum Catalyst of the Contact Sulphuric-Acid Reaction.* **G. L. Clark, P. C. McGrath and M. C. Johnson.** (Nat. Acad. Sci., Proc. 11. pp. 646–651, Oct., 1925.)—The authors criticise the statement of Schwarz and Klingenfuss [Abstract 984 (1923)] that exposure to X-radiation increases the activity of platinised asbestos, because the former had conducted the air and SO_2 separately through their converters. They pass the two gases simultaneously through a pyrex glass (not quartz) converter tube ; the catalyst is placed in the central, thin part of the tube which is otherwise wrapped with asbestos and heater coils in several layers. When the gas mixture was dried (by P_2O_5), so that after two weeks' working the conversion ratio had diminished to 3·25 %, the X-radiation had no effect. When the mixture was moist, the conversion ratio was 88 % and rose, after X-radiation, to 94 %, but dropped after about five hours slowly, to recover somewhat afterwards. The authors agree with Schwarz and Klingenfuss that the effect of moisture cannot merely be due to adsorption of the gases, but must be due to some chemical combination; the drop may be ascribed to the adsorption of a film of H_2SO_4 on the catalyst, but further experiments are required. H. B.

410. *Photo-activation of Chlorine.* **E. J. Bowen.** (Phil. Mag. 50. pp. 879–880, Oct., 1925.)—Taylor [see Abstract 2182 (1925)] takes no account of the fact that the amount of light absorbed varies with the wave-length. For a weakly absorbing substance like chlorine the amount of light absorbed may be assumed to be proportional to the extinction coefficient. Correction of Taylor's table in this respect by means of the results of v. Halban and Siedentopf [Abstract 895 (1923)] leads to the conclusion that the Ribaud fine-structure bands of chlorine are photo-active and that, within the limits of experimental error, the reaction rate is directly proportional to the number of light-quanta absorbed. Whether the heat of dissociation of chlorine is to be related to the absorption spectrum is left undecided by these experiments. T. H. P.

411. *New Aspect of the Photochemical Union of Hydrogen and Chlorine.* **R. G. W. Norrish.** (Chem. Soc., J. 127. pp. 2316–2334, Oct., 1925.)—Coehn and Jung have shown [Zeits. phys. Chem. 110. p. 705, 1924)] that, while the rate of combination of hydrogen and chlorine in visible radiation is not influenced by desiccation of the gases to a water-vapour pressure of 10^{-4} mm., it approaches zero when a value between 10^{-4} and 10^{-7} mm. is reached. It is now suggested that the primary photochemical reaction—the dissociation of the chlorine molecule into atoms—occurs only at the water film covering the walls of the vessel and that its rate is uninfluenced while the surface layer of water is saturated, but decreases when this is only partly saturated at low vapour pressures. The resulting "Nernst chains" must extend outwards into the gaseous phase, and be destroyed on meeting the surface again. Development of this hypothesis leads to an expression in full agreement with the results of Chapman's quantitative researches [Abstract 2741 (1924)]. This view may be extended to account for the phenomenon of photochemical induction as a surface poisoning effect by ammonia derived from traces of nitrogenous impurities. It is assumed that ammonia combines preferentially with the catalytically active water film, and that its removal by photochemical action with the chlorine is necessary before the primary reaction can occur. Quantitative study of the induction period produced by adding known doses of ammonia to the hydrogen-chlorine system gives results expressible by the formula, $T = apv\left(1 - \frac{b}{P}\right)s$, where T is the induction period, p, P are the pressures of ammonia and chlorine, v and s are the volume and surface of the reaction vessel, and a and b are constants; these results are consistent with the above surface-poisoning theory. T. H. P.

412. *Equilibrium of Carbon Dioxide, Carbon Monoxide and Oxygen in the Corona Discharge.* **G. L. Wendt and Marie Farnsworth.** (Am. Chem. Soc., J. 47. pp. 2494–2500, Oct., 1925.)—The corona discharge is capable of bringing about a large number of reactions, many of which are listed by Berthelot, Löb and Lorentz. Their general relation to thermodynamic considerations has not been established. In the reaction

$2CO + O_2 \rightleftharpoons 2CO_2$, which is brought about by corona discharge with a very slight elevation of temperature, the equilibrium thermodynamically requires very high temperatures. A study was made of the corona discharge which brought about equilibrium in about three-quarters of an hour, in carbon dioxide or a mixture of carbon monoxide and oxygen. The equilibrium corresponds to a decomposition of 28·54 % of the carbon dioxide. This decomposition corresponds thermodynamically to a temperature of 2600° C. Under the conditions of the experiment the temperature was only slightly above room temperature. The electrical discharge increases the reactivity of all three types of molecules present in such a way as to increase the reaction velocities at ordinary temperatures, and thus produce a shift of the equilibrium concentrations to those corresponding to high temperatures, without in any way heating the gases.

F. J. B.

413. *The Chemical Effects in Ionised Organic Gases.* **S. C. Lind** and **D. C. Bardwell.** (Science, 62. pp. 422–424, Nov. 6, 1925.)—The authors have previously published an account of the effect produced by ionising pure ethane by mixing radon with it, and they have now made similar experiments with methane, propane, butane, ethylene, acetylene, cyanogen, hydrogen cyanide and ammonia. They have also studied oxidation of most of the above gases, hydrogenation of some of them and polymerisation (also in the presence of nitrogen) of acetylene, cyanogen and hydrogen cyanide. In the case of methane, ethane, propane and butane a sort of condensation takes place with elimination of hydrogen, a liquid or solid condensate being formed, the yellow or brownish colour of which is attributed to unsaturation. For details of the behaviour of the different substances the original paper should be consulted.

H. N. A.

414. *Secondary Reaction in the Discharge of Lead Plate Accumulators.* **C. Féry** and **C. Chéneveau.** (Comptes Rendus, 181. pp. 606–608, Nov. 3, 1925.)—Observations of the changes in weight of accumulator plates during discharge are found to disagree with the theory of double sulphatation based on the reversible reaction :

$$Pb + 2H_2SO_4 + PbO_2 \rightleftharpoons PbSO_4 + 2H_2O + PbSO_4$$

and also with the later theory involving the reaction :

$$Pb_2 + H_2SO_4 + Pb_2O_5 \rightleftharpoons Pb_2SO_4 + H_2O + 2PbO_2$$

An explanation of the divergence is advanced on the basis of considering the electrolyte as a saturated solution of lead sulphate in acidulated water, a secondary reaction $Pb + Pb_2O_5 + H_2SO_4 = 2PbO_2 + PbSO_4 + H_2O$ being suggested as in accord with observations.

A. B. C. L.

415. *Saturated Standard Cells with Small Temperature Coefficients.* **W. C. Vosburgh.** (Am. Chem. Soc., J. 47. pp. 2531–2540, Oct., 1925.)—The two types of Weston cell, the saturated or normal cell and the unsaturated cell, are used as standards of e.m.f. The normal cell has the advantage of being reproducible and constant, but it has a considerable temperature coefficient. By substituting a cadmium-tin-amalgam electrode for the cadmium-amalgam one, the e.m.f. was increased from 1·01805 volts to 1·101901 volts at 25° C., and the temperature co-efficient was decreased to about two-fifths that of the normal Weston cell. The cell thus formed was as reproducible and nearly as constant as the normal Weston cell. A similar cell with a cadmium-lead-amalgam electrode had an e.m.f. of 1·01918 volts at 25° C. and a higher temperature coefficient than the cell containing tin. Similar amalgam cells with bismuth in one amalgam showed that the substitution of a cadmium-bismuth amalgam for the cadmium amalgam in the Weston cell resulted in an e.m.f. of 1·01976 volts at 25° C. The temperature coefficient was positive and equal to the negative temperature coefficient of a similar cell with a cadmium-tin-amalgam electrode. An amalgam electrode containing copper had an e.m.f. of 10 m.m. v., showing that copper in the amalgam of the Weston cell would not appreciably alter the e.m.f. or temperature coefficient.

F. J. B.

416. *Improved Continuous-reading Hydrogen-Ion Meter.* **K. H. Goode.** (Am. Chem. Soc., J. 47. pp. 2483–2488, Oct., 1925.)—In order to avoid the use of a reading telescope and scale for classroom demonstration, or for routine titration work, advantage is taken of the amplifying characteristics of the vacuum tube to magnify currents to such a value that they can be measured with a milliammeter. The apparatus described uses a three-electrode vacuum tube as a voltmeter, and as a direct-current amplifier; by this means an indication upon the scale of the milliammeter is obtained of the potential between any two electrodes ordinarily used in electrochemical work. The device avoids drawing any appreciable current from the cell being measured, and is continuous and automatic in operation. It is especially adapted for electrochemical titration.

F. J .B.

417. *Electrolytes in Solutions of Low Dielectric Constants.* **P. Gross** and **O. Halpern.** (Phys. Zeits. 26. pp. 636–642, Oct. 13, 1925.)—According to previous conceptions, the phenomena observed in solutions of low dielectric constants are explained qualitatively by a number of independent hypotheses, among which the idea of association plays a predominant part. Such hypotheses are not related to the fertile electrical theory of aqueous solutions of electrolytes and leave unexplained the essential correlation between strong association and pronounced (anomalous) electrical conductivity. Bjerrum's theory of complete dissociation, regard being paid to interionic forces, has, in the form given to it by Debye and Hückel [Abstract 1267 (1925)], furnished satisfactory quantitative agreement with experimental results. As the dielectric constant diminishes, the influence must assume increasing importance, even when dissociation is incomplete. With the aid of the conditions governing thermodynamic stability, the usefulness of which in the qualitative treatment of questions like solubility and dissociation is not yet exhausted, this theory is capable of yielding qualitative indications of the course of the phenomena in solutions of low dielectric constants and also of defining approximately the limits of the region in which anomalous behaviour appears.

T. H. P.

418. *The Conductivity of Univalent Salts in Methyl Alcohol at 25° C.* **J. E. Frazer** and **H. Hartley.** (Roy. Soc., Proc. 109. pp. 351–368, Oct. 1, 1925.)—The electrical conductivity between N/10000 and N/500 of fifteen univalent salts in methyl alcohol is measured at 25° C. Confirmation is obtained of the applicability of Kohlrausch's law of the independent mobility of ions and of the square root relation $\Lambda_\infty - \Lambda_c = x\sqrt{C}$. It is found that in methyl alcohol, as in water, the mobilities of the ions of the alkali metals increase with increasing atomic number and atomic volume but in methyl alcohol the rise is more regular. With the halogens, the mobilities in methyl alcohol rise regularly with the atomic number, but in water chlorine, bromine, and iodine have nearly the same mobility, the value for bromine being slightly the highest. The ratio of the mobilities in the two solvents varies from ion to ion indicating that there is no simple relation between them. The values of Λ_∞ are plotted against the equivalent concentrations and it is seen that the slopes of the lines are about four times as steep in methyl alcohol as in water and show more definite differences. The results are in approximate agreement with the Debye theory of conductivity but indicate that some minor revision of the theory is necessary. J. N. P.

419. *Electrolytic Oxidation of Tetravalent Molybdenum Octocyanide.* **O. Collenberg** and **B. Andersen.** (Zeits. Elektrochem. 31. pp. 558–565, Oct., 1925.)—The electrolytic oxidation of tetravalent molybdenum octocyanide was studied. It was found that the reaction took place rapidly on electrodes (anodes) of gold, platinum, nickel, and iron. Only slight polarisation took place on these anodes. In neutral molybdenum cyanide solution gold and platinum behaved as unattackable electrodes, while nickel and iron behaved as soluble anodes and became covered with a layer of insoluble molybdenum cyanide. Owing to its porous nature the deposit did not cause any considerable polarisation. In alkaline solution nickel and iron became passive, if the alkalinity were high, and showed the same small polarisation as gold and platinum. Molybdenum cyanide can be electrolytically oxidised in alkaline, neutral or acid solutions with platinum electrodes. In alkaline solution the oxidation is incomplete. In favourable cases 72 % of the tetravalent cyanide was oxidised. It is not possible to carry out the oxidation in a neutral solution unless another salt is present. The oxidation takes place quantitatively, if the neutral solution contains sufficient K_2SO_4 to render it 0·1 to 0·2 N. It is best carried out at 45° C. and a current density of 0·0056 amp. per sq. cm.

The oxidation also proceeds quantitatively to pentavalent cyanide in sulphuric acid solution. Too great a concentration of H_2SO_4 brings about decomposition. The best conditions are 0·2N H_2SO_4, at 45° C. and a current density of 0·0056 amp. per sq. cm. F. J. B.

420. *Electrolytic Reduction of Tungstic Acid.* **O. Collenberg** and **K. Nilsson.** (Zeits. Elektrochem. 31. pp. 555–558, Oct., 1925.)—The electrolytic reduction of tungstic acid in oxalic acid solution, employing electrodes of different metals, was determined. It was found that an oxalic acid solution of alkali tungstates can be electrolytically reduced on different electrodes under definite conditions. The reduction to pentavalent tungsten takes place completely on tin and lead electrodes and partially on mercury and platinum, but in no case does the reduction proceed to a further stage. The reduction is best effected in a strong solution of oxalic acid and at raised temperatures (at least 70° C.). The electrolytic reduction can be used advantageously for the preparation of pentavalent tungsten oxalate complexes. F. J. B.